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George Eastman—Greatest Amateur Photographer

The remarkable story of an idea worth millions—How a young bank clerk took the mystery out of a magic art and put cameras in the hands of every one—What we may expect from photography in the future

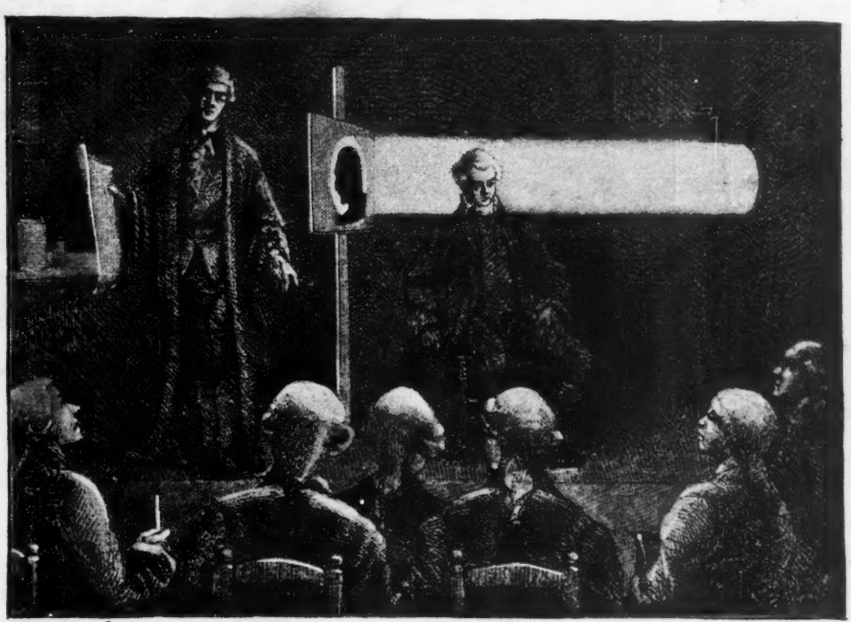
By Raymond J. Brown

ABOUT 47 years ago, a young man of 24 became seized with an idea regarding a hobby to which he had been devoting all his spare time. By day this young man was bookkeeper in a savings-bank in Rochester, N. Y. By night and on his holidays he was a scientific experimenter, although he would scarcely have applied that name to himself. His hobby was photography, which at that time, in 1878, offered fewer inducements by far to a young amateur investigator than aviation, say, does now.

In fact, it may be said there were almost no amateur photographers in those days. Photography was a deep mystery to the ordinary person, a sort of black magic. Taking a single picture was very often a day's work, and required such fine skill and expert knowledge and such elaborate, costly and cumbersome equipment, that the few who had mastered the art were glad to capitalize their knowledge by utilizing it professionally.

The photographer, for example, had to be a practical chemist, capable of taking a sheet of glass and several bottles of chemicals and manufacturing a "plate" on the spot by the complicated wet-collodion process each time he wished to take a picture. Since this work and the subsequent loading of the camera had to be performed in darkness, it was necessary that he carry a lightproof tent or shelter whenever he ventured to take landscapes or other outdoor photographs.

A heavy view camera, an awkward tripod, quantities of chemicals and a bucket of water were added details that made the luggage of the photographer of 1878 about equal in weight and bulk to the camping gear of the well-equipped automobile tourist of today.



Taking a Picture in the Olden Days—A Silhouette

One of the first attempts to make a photograph, in the early eighteenth century. The subject to be "photographed" sat between the source of light and a sheet of sensitized paper fastened on a board. His shadow blocked off a certain proportion of the light rays, and as a result his profile in silhouette was left on the paper. This image, however, faded in a few minutes

Now, the idea that the young man in Rochester conceived about all this was that the photographic process was needlessly complicated. He knew the pleasure that he had derived from pursuit of his hobby; he assumed that others would find equal pleasure in it if only the tedious, almost overwhelming difficulties of its practice could be eliminated. And since no one else appeared eager to simplify photography, he decided to attempt the thing himself. So he hired a little room over a shop and began to experiment.

The results of those early experiments you see everywhere about you. They supply one of the most thrilling romances of modern business, one of the most inspiring chronicles of scientific achievement of all time. For within two years the young man in Rochester was manufacturing one of the best of the early dry plates that eliminated much of the unwieldy equipment of the photographer.

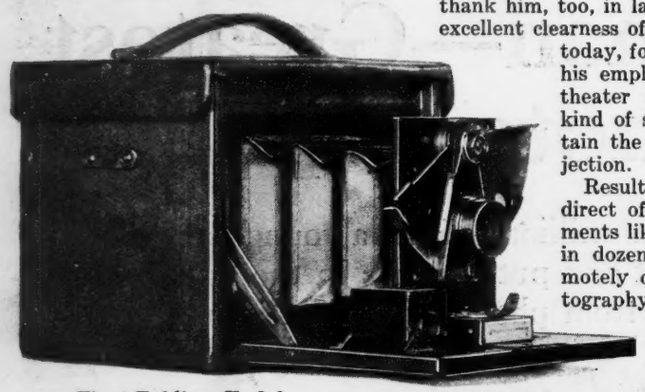
Within five years he had paved the way for the motion picture and for

How I Use My Copy of Popular Science Monthly

A LIST of the names of the prize-winners in the contest announced in our October issue will be found on page 4 of this issue.

the enormous present-day popularity of amateur photography by the substitution for the glass plate of a roll film of paper.

Within 10 years he had produced a camera with which the novice, on his first attempt, could take good pictures simply by pointing the camera at his subject and pressing a button. Moreover, he had added a new word to the language—"kodak," which he coined himself and



First Folding Kodak

Produced in 1892, it made a four-by-five picture, and was heavy and cumbersome compared with the trim kodaks of today

which you'll now find defined in any dictionary as "a portable camera for taking instantaneous photographs"—an honor which rarely if ever has been accorded to the copyrighted trade name for a commercial article.

Within 11 years he had made commercially practicable the present cellulose film. Within 13 years he offered a camera that could be loaded in daylight. Within 20 years it is safe to say that there was scarcely a person in the civilized world who had not made "snapshots" or been the subject for "snapshooting."

Today it is virtually impossible for anybody anywhere to pursue his daily activities without encountering in one form or another some of the far-reaching developments that can be traced directly to the experiments that the young man in Rochester instituted in his laboratory almost a half century ago.

You can't walk through the streets of the smallest village or the greatest city, go on a railroad journey, automobile tour, or boat trip, take a Sunday afternoon walk or a summer vacation without encountering kodaks. If you don't see them in use, you see them displayed in an amazing variety of stores, or you see kodak pictures in your home, or in your office or shop.

There are upward of 200 illustrations in this magazine, and a goodly portion of them are reproductions of kodak pictures made by amateur photographers. Probably you own a kodak yourself; if not, it is likely that some member of your family does; certainly you would find it difficult to name three families of your acquaintance in which there is not at least one.

When you go to the movies, the pictures you see are direct results of that young man's experiments of 47 years ago, for he made possible the photographic film, and now makes practically all the motion-picture film used in America. That you can see your way to your seat in a motion-picture theater now, instead of stumbling around in the dark as you used to do, is due to the fact that methods of showing pictures in lighted theaters were devised in his laboratories. You can thank him, too, in large measure for the excellent clearness of the movies you see today, for it was scientists in his employ who taught the theater owners the proper kind of screen to use to obtain the best values in projection.

Results both direct and indirect of those early experiments likewise are felt today in dozens of fields only remotely connected with photography—in industry, medicine, and diverse branches of scientific research. Developments springing from those experiments were of signal use, too, in the late war—in the perfection of naval camouflage, in aerial photography, in the training of airplane gunners.

The First Real Portrait Ever Taken

Above is a reproduction of the earliest sunlight picture of a human face. It is a daguerreotype of Miss Dorothy Catherine Draper, and was taken by her brother, Prof. John William Draper, M.D., LL.D., of the University of the City of New York, early in 1840. The subject had to sit motionless in bright sunlight for about six minutes, in striking contrast with the instantaneous photography that is possible today

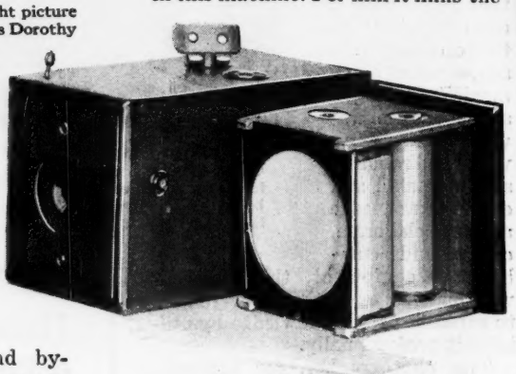
In fact, the ramifications and by-products of those attempts 47 years ago to simplify the making of photographs are so amazingly complex and extend in so many different directions that merely to catalogue them probably would take as much space as this entire article.

You may have noticed that I have not yet mentioned the name of the man of whom I write. Probably I might refrain from doing so entirely without fear of any one's failing to know exactly whom I mean, for the development of no other art, science, or industry probably is so inseparably linked with the name of one man as is the development of photography, particularly as it affects the amateur, with the name of George Eastman. And yet it is surprising to what a limited degree any knowledge of this man, beyond the fact, of course, that he is at the head of one of the world's great commercial enterprises, has traveled beyond his home city of Rochester.

OTHER great inventors, other great industrial leaders, other great philanthropists—and George Eastman is all of these—are known widely, quoted widely, pictured widely. But the personality of George Eastman has remained screened behind the results of his labors—a fact that becomes the more astonishing when you meet him, for he is an affable, colorful, buoyant, amazingly youthful man whose enthusiasm for the accomplishments of the enormous plants and the vast army of workers that are now the Eastman Kodak Company is as lively as was his interest in his own experiments when he was just a young bank clerk trying to make the practice of his hobby easier for himself and others.

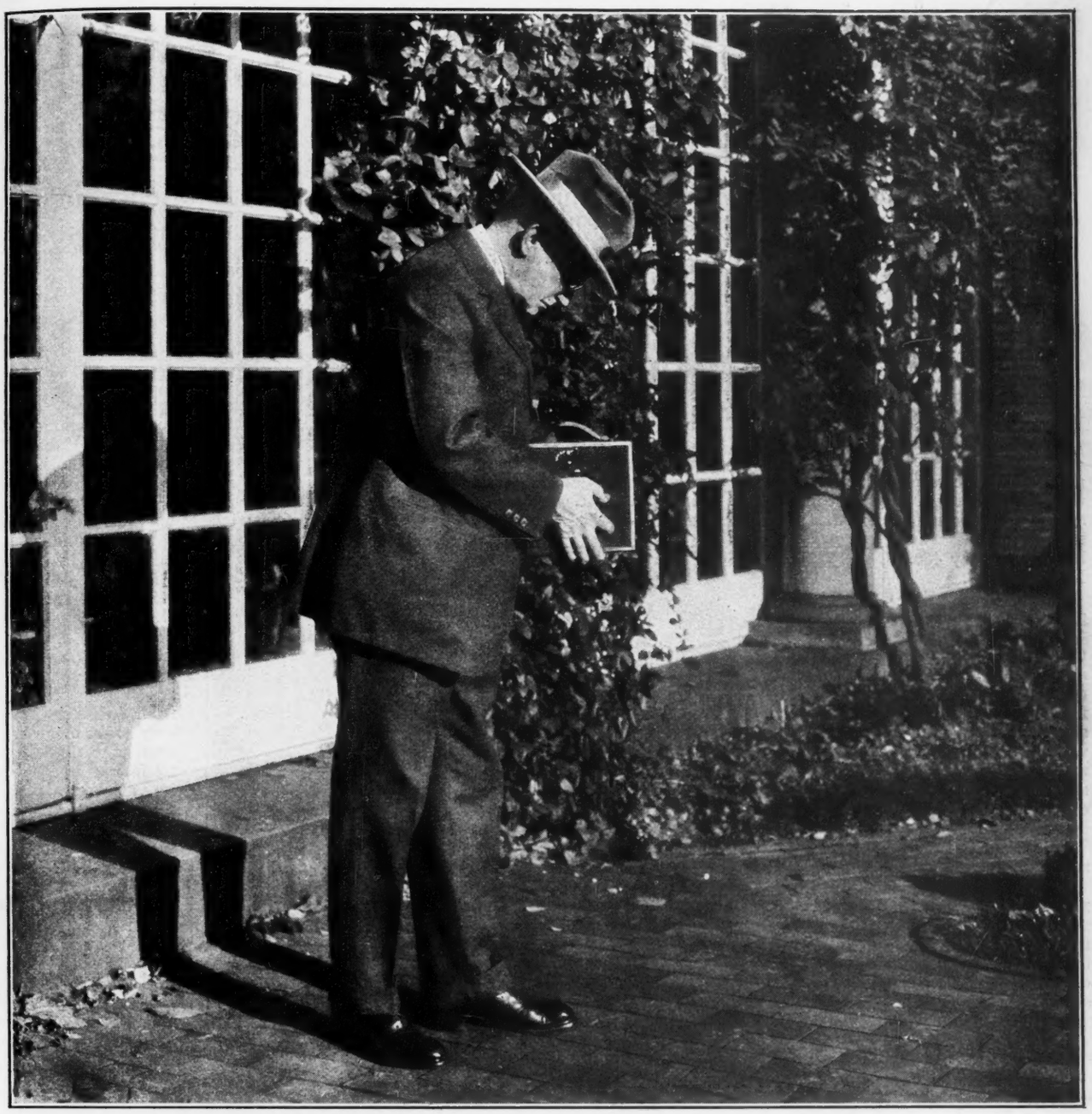
There was a vibrant ring in his voice and a glitter of pride in his keen eyes as he showed me, in his office in Rochester the other day, the latest triumph of his great factories—the ciné-kodak, a compact, entirely foolproof motion-picture camera for amateurs, the operation of which is so simple that it makes tuning a one-tube radio receiver seem like a scientific achievement by comparison. Nor do I make that assertion by hearsay. Though I would not call myself even an amateur photographer, I went out and made pictures with the camera—good pictures—and projected them on the screen a few hours later with the projecting machine that is part of the outfit.

There is a reason why Mr. Eastman should be especially interested in this machine. For him it links the



The Father of the "Brownie"

The original Eastman kodak of 1888—father of the present-day "Brownie," which it resembles. Compared with the pocket folding kodaks of today, it is somewhat crude and clumsy; yet compared with the cumbersome equipment that confronted the amateur prior to its appearance, it was a marvelous achievement of inventive genius



Eastman at His Hobby—Taking a Picture with His New Amateur Movie Camera

This is one of the few photographs for which George Eastman has posed. It was taken especially for *Popular Science Monthly* in the garden of his home in Rochester, N. Y., and shows him operating the latest triumph of his great factories—a compact, foolproof motion-picture camera for amateurs. This little machine, representing five years of research, he says, has at last fulfilled the dream of "movies in the home." In the 47 years since the time when, as a young bank clerk, he began experimenting with cameras, Mr. Eastman has revolutionized photography and has established one of the most remarkable industrial enterprises in the world; yet he still classes himself as "an amateur photographer." Today, at the age of 70, he retains the enthusiasm of the amateur and the keen interest in scientific progress that have marked his achievements, and that have built up his wonderful organization. "I often buy *Popular Science Monthly*," Mr. Eastman told the author of this article. "I want to keep informed on new developments in science and mechanics, and *Popular Science Monthly* enables me to do so in an easy and interesting way"

present with the past; it does for motion pictures exactly what he did for still pictures when he produced the first kodak in 1888—so simplifies their making that the veriest novice can take good pictures from the start.

"This little machine," said Mr. Eastman, "represents five solid years of research. People have been talking for several years about 'movies in the home' as an interesting possibility of the future. Now that the ciné-kodak is here, the future has arrived in that respect. Anybody who can read a set of simple instructions can make perfect motion pictures with this machine; can make them, too, at one-fifth what it costs for the mere developing and printing of an equivalent length of standard film.

"WHEN we first made kodaks, we had a slogan, 'You press the button; we do the rest.' We might well revive that for these machines, for we are equipping some of them with electric motors to turn the film, which makes pressing a button all the operator need do. We develop the film without cost. We don't print it, for that has been made unnecessary by an ingenious process recently developed in our research laboratory whereby a negative film can be reversed and turned into a positive ready for projection.

"It is this that has made possible the ciné-kodak for home use. Without this process, the cost of making motion pictures undoubtedly would be prohibitive for the ordinary amateur. Now, though, any one can chronicle the development of his children, record his vacations, picturize any event he may wish in motion pictures that he can see in his own living-room whenever he

(*Continued on page 141*)

When Men Race with Death to Make the Air Safe

The story of a hazardous sport that has joined hands with science in amazing tests of speed and skill—How a plane is launched from an airship—Amateur flights point the way to a new day of safe, practical, and cheap air flivvers

By Peter Vischer

A TINY speck grows in the sky. In an instant, a dot high up against the heavens becomes a glistening pair of wings, shooting down at the ground, almost straight, at incredible speed. No one knows how fast; some say 300 miles an hour; some say 450. No one knows.

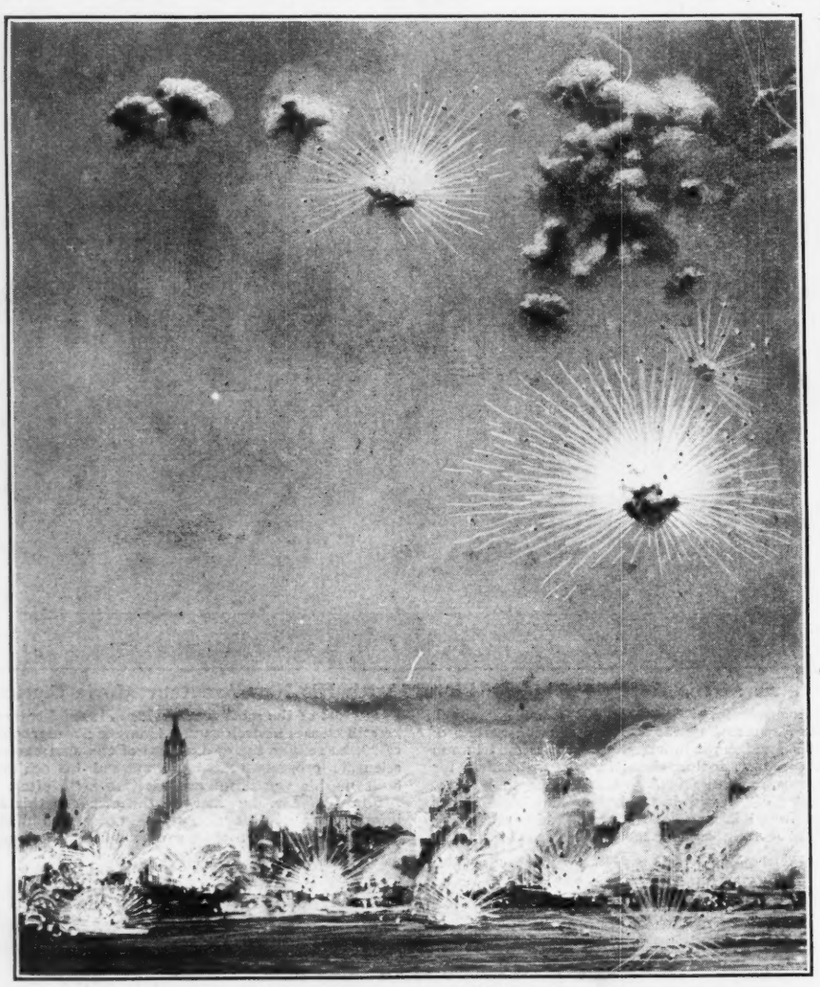
Just before the ground is reached, when it seems as though this whizzing streak must be crashed to earth before your eyes, it straightens out and with a thrilling and awe-inspiring grace speeds off into the distance, far and away.

That's airplane racing.

A hazardous sport, you say. Hazardous, yes; no man is so fearless of death, so utterly contemptible of death, as is the airplane racer. A sport? Yes and no.

THE men who race in airplanes don't consider racing a sport. They look upon it as scientific research. Speed, speed, and more speed. It is absolutely necessary, they believe, for the proper development of aeronautics, not half so much for the hanging up of new records as for the study of strains and stresses.

Through the apparently reckless stunts of racing, pilots and designers learn how airplanes may be expected to act under all circumstances. Consider again the swishing dive of the air racers. The spectators at the recent International Air Races at Wilbur Wright Field, Dayton, Ohio, were thrilled when a small messenger plane, hooked under the car of an army dirigible, was released and took the air. The same dive, the same straightening out and the same soaring away into the distance marked this feat, so graphically shown on the cover of this magazine.



City of Skyscrapers Attacked from the Air

The destruction of a model City of New York in 30 minutes by air raiders was the startling spectacle that closed the recent International Air Races at Dayton, Ohio. This illustration shows the aerial bombs bursting among the city's skyscrapers, and in the air the exploding shells from anti-aircraft guns. The spectacle was staged as a demonstration of the deadly effectiveness of aircraft as weapons of modern warfare, and imagination supplies its horrors

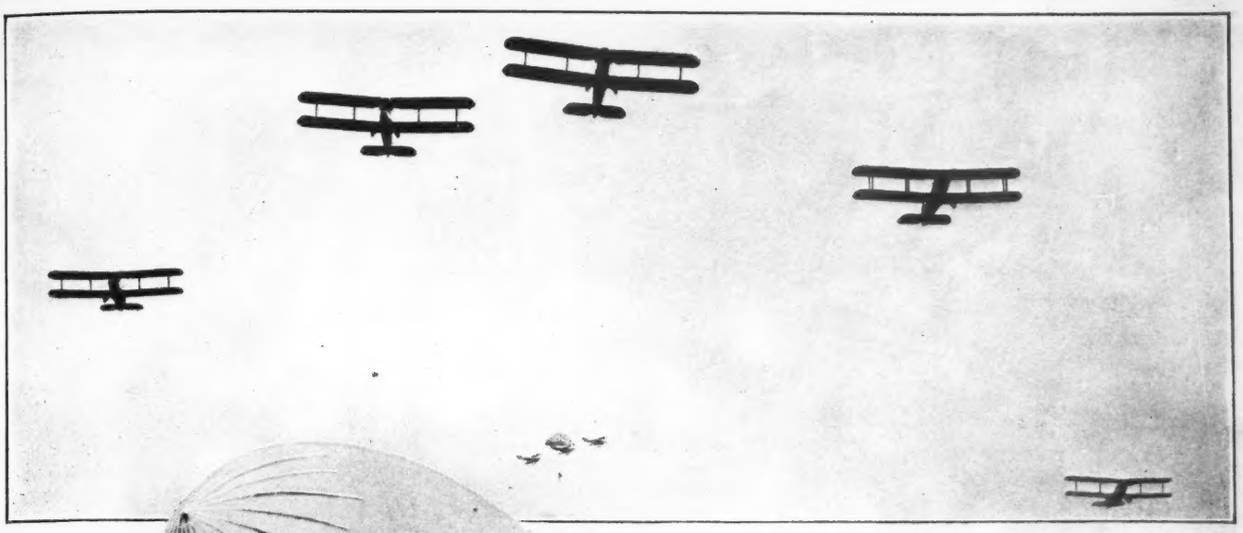
Not only can an airplane be started from a dirigible, but it can return to its perch by means of an automatic attaching device. Future-looking aeronautical engineers see in this new development great promise for the success of commercial aviation. They can visualize "feeder" lines for cross-country dirigible liners. A dirigible going from New York to Chicago, for instance, could take passengers for intermediate points and could set them aground without delaying the straightaway flight of the mother ship. In the same manner new passengers could be taken aboard.

Maneuvering messenger planes to and from dirigibles, however, takes more than ordinary skill. Here again racing proves its value. It teaches pilots how to handle their machines under the most trying circumstances.

SO THE people who go to airplane races — and some 50,000 went to the recent meet in Dayton — may look upon racing as a sport, but racers don't. They look upon racing as a serious occupation, so necessary that life is not too much to risk for it.

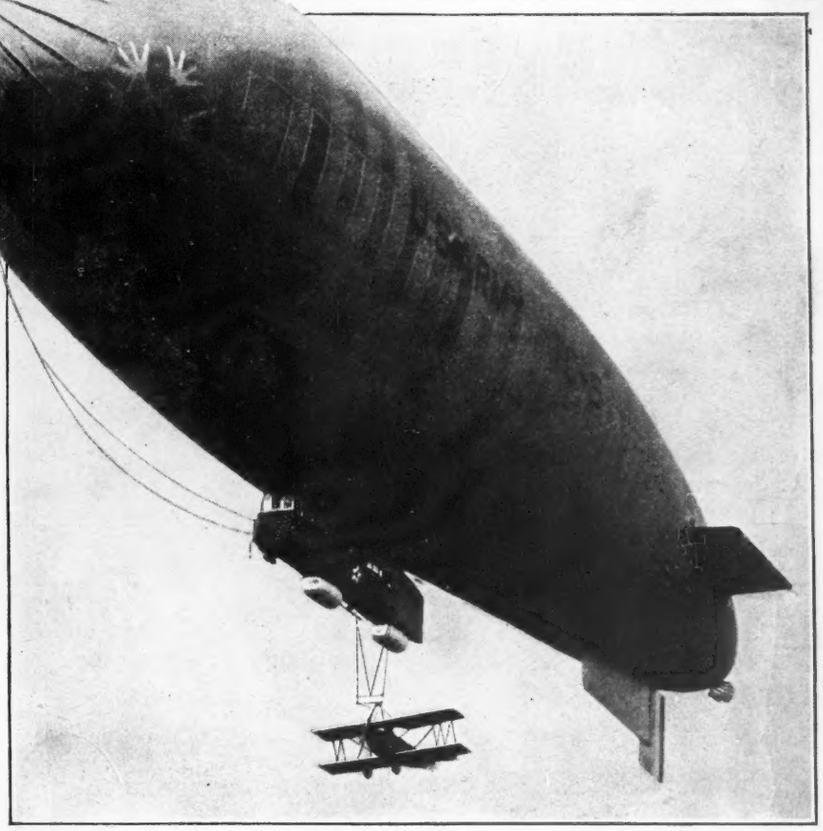
And once in a while a life has to be given. At the Dayton meet, Capt. Burt E. Skeel, as fine a pilot as the U. S. Army had in its ranks, gave his life to racing.

Captain Skeel was diving for the starting line in the Pulitzer Race, the world's premier event for airplane races, when he met death. His plane, a Curtiss R-6 racer, one of the fastest machines in the world, was dropping out of a leaden west, diving for the starting pylon, going at a speed greater than any that ever had been recorded. Suddenly, as his plane was



A Parachute Jump

Above: One of the many thrilling sights of the Dayton Air Races—a parachute jump from one of a number of planes in flying formation. The parachute can be seen in the distance, at the lower center of the photograph, with two planes hovering on either side of it



Plane Launched from Airship

At left: A small army messenger plane hooked under the car of the U. S. Army dirigible TC-5, ready to take the air. This was one of the amazing feats performed at the Dayton races. Not only can a plane be launched from an airship, but it can return to its perch by means of an automatic attachment

dashing toward the ground, it was seen literally to fall apart. A wing dropped off, and fluttered to the ground like a piece of paper. The entire fuselage of his plane burst into fragments. The engine, and with it the courageous Skeel, plunged toward earth, landed in a swamp, and buried itself feet deep, throwing huge clods of earth for hundreds of feet.

Curiously enough, despite the tremendous hazards of speed racing in airplanes, Skeel's death was the first fatality in a Pulitzer Race. The results, on the other hand, have been most gratifying. Americans hold the world's speed record as a result of the Pulitzer Races, a record established in 1923 by Lieut. A. J. Williams of the U. S. Navy, known to thousands as "Al" ever since he pitched baseball for the New York Giants. Williams went at the rate of 243.67 miles an hour, a mark no European machine has been able to approach.

THERE wasn't a chance of beating Williams' mark in the 1924 race, because there was no new machine in the race. Lieutenant H. H. Mills of the army won in a Verville-Sperry racer, a monoplane that looks like a darning-needle, but he couldn't make it go any faster than 216.55 miles an hour, which is almost 30 miles slower than the record of Lieutenant Williams.

Airplane designers are satisfied that the speed limit by no means has been reached. Captain Skeel before his death said he was certain that 300 miles an hour on the straightaway would be done within a very few years. He said that a machine able to go 265 miles an hour already had been designed.

A speed of 300 miles an hour on turns is a courageous thing even for a flier to predict. When a plane takes a corner at terrific speed, the centrifugal force draws the blood from the pilot's head and into his feet. For a moment things go completely black and a pilot is to all intents and purposes unconscious.

Yet the pilots can do it if the planes can, aviators say. We are building our planes so well now that the pilots are well protected and do not suffer at high speeds. There is a limit beyond which no man will be able to go, of course; but just what that limit is, nobody knows.

One of the most daring of all the speed pilots is Lieut. Russell L. Maughan, a one-time Pulitzer Race winner. He takes corners within 20 feet of the ground, often within six feet, with his plane virtually vertical. He makes spectators gasp for breath. Yet he, too, believes that the speed limit by no means has been reached.

THOSE who witnessed the recent international air races may well appreciate what 265 miles an hour means. They saw Lieut. John A. Macready, crack American flyer, who participated in the non-stop transcontinental flight, go up in a Wright machine 20 years old, the second built by the famous brothers.

It looked as though Macready was taking his life in his hands, the Wright machine was so frail. It seemed nothing but a bundle of bamboo sticks tied together with a bed-sheet. It went up so wabbly, faltering and wavering, until it looked as though any moment it would come down in a heap. But it didn't.

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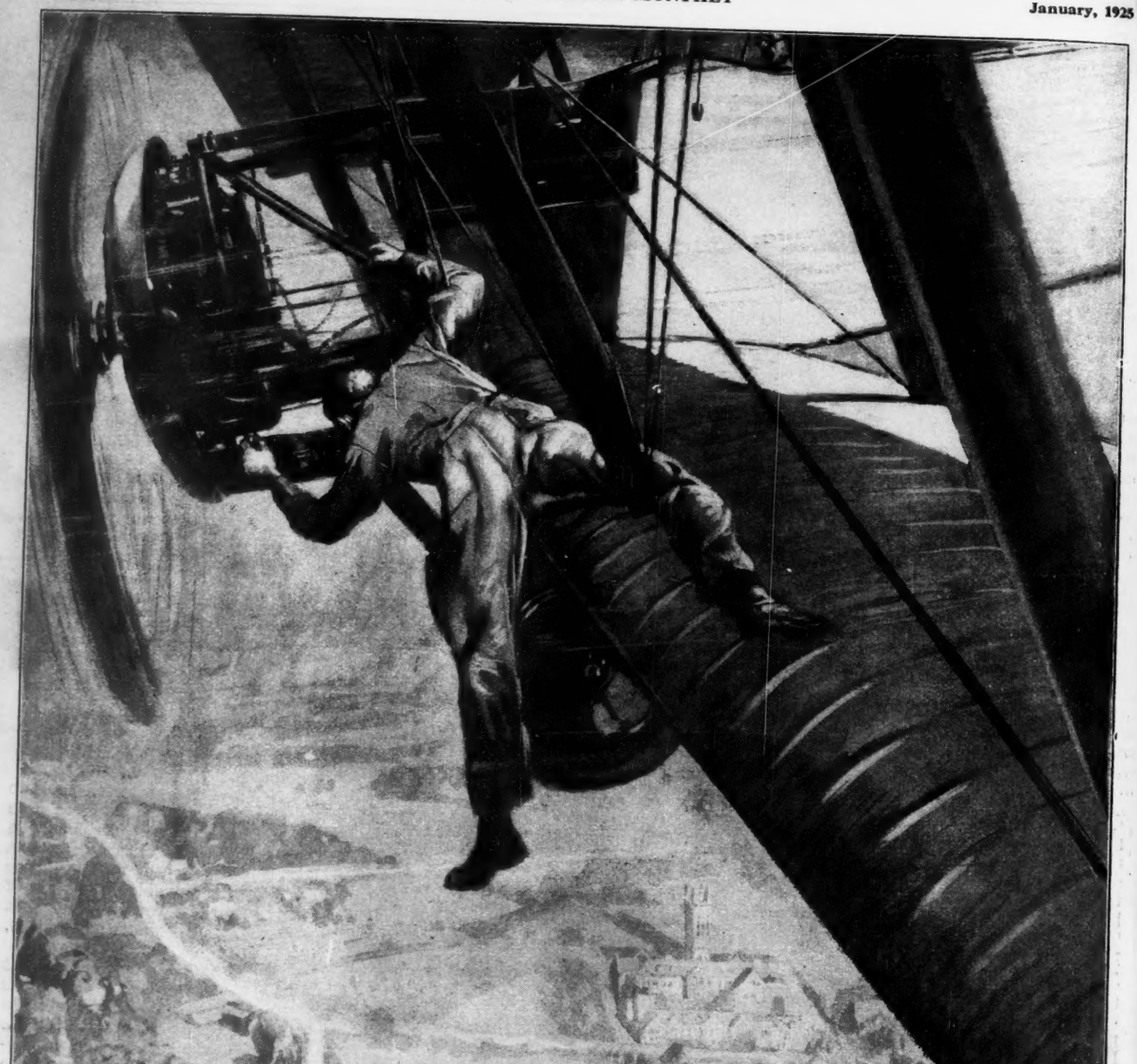


An Air Hero—Holding the Break

How a Mechanic, Dangling from Wing, Saved His Plane

IN MOMENTS of extreme danger at sea and on land—when wrecks, collisions, or conflagrations have seemed imminent—there have been numbered countless heroes who have stuck to perilous posts to safeguard the lives of men and women intrusted to their charge. But few more daring or courageous than the young airplane mechanic who, to save his pilot and passengers from possible disaster, climbed out on the wing of a giant Croydon-to-Paris passenger plane, and there held fast to a broken control for 40 minutes, until the plane landed.

The great machine—one of those engaged in regular passenger service across the Channel—was flying high over the English countryside, when without warning the control arm of the engine carburetor broke, cutting off the gasoline.

Instantly the mechanic crawled out on the lower wing of the plane in an attempt to repair the break. Finding this impossible, he decided the only thing to do was to hold the broken control.

Thus, with one leg hooked about a strut of the plane, the other dangling over the edge of the wing, he hung on grimly minute after minute while the liner sped toward its airdrome.

In the illustration above, our artist has thrillingly portrayed the reckless courage of this hero of the air.

A Thrilling Search for Wealth in the Wilds of Alaska

Geologists Survey Resources of Oil and Metals in Far North

By Norman C. McLoud

A FEW weeks ago there emerged from the wilderness of northernmost Alaska a little band of government scientists after seven months of thrilling adventure and hopeless isolation in the heart of the frozen North. They had penetrated into the terrifying bleakness and desolation of the last remaining frontier of the American continent to measure its potential wealth—to survey the region for oil and precious and useful metals and to seek possible routes for transporting these valuable deposits to the doorway of civilization.

The party was composed of geologists and topographers of the United States Geological Survey—four scientists and four assistants. Throughout their journey the treacherous hand of danger constantly reached out to snatch them; and the least mischance might easily have brought serious consequences. Breaking ice blocked the river channels through which they traveled, and imperiled the frail sides of their canoes. The dogs that drew their supplies ate more than they could haul in the sledges. Bitter cold—the kind that "runs out of the bottom of the thermometer"—sapped their energies and gnawed at their morale.

THEY set up their instruments and made their sketches with fingers that were stiffened and all but useless from the awful cold, with eyes blinded from the dazzling snows. For a period that most of us would have deemed interminable, they were marooned, with scant rations and no avenue of escape, on a bleak island in the Arctic Ocean. For weeks their only fresh food was won by skilful marksmanship that brought down an occasional bighorn sheep.

Their return to civilization was accomplished only through a chance encounter with a government vessel cruising the Alaskan shores in search of shipwrecked sailors, after they had completed a 150-mile canoe trip through the icy, turbulent waters of the Arctic Ocean.

In his steam-heated office in Washington—a retreat that offered a startling contrast with the barren region he had just left—Dr. Philip S. Smith, leader of the expedition, sketched for me, a few days ago, a thrilling chronicle of the adventures of his party. Doctor Smith is a geologist, a stalwart giant, with a record of a dozen years or more in the Alaskan wilds. Second in command to him was Dr. J. B. Mertie, another six-footer of long experience in pursuing scientific investigation under the most hazardous conditions. The other members of the party, too, were vigorous, outdoor men, chosen for this dangerous work because they possess the unusual combination of scientific knowledge and skill, with ability to cope with the ravages of Nature in her cruelest moods.

The goal of the explorers was the area known as Naval Petroleum Reserve No. 4, an area as large as the combined states of New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. Within the 35,000 square miles of this region previous perfunctory surveys had shown unmistakable evidence of oil and mineral wealth that invited American development, so the area was created a Naval Reserve last year and the Geological Survey was directed to establish its possibilities.

The Leader of the Expedition

Dr. Philip S. Smith, geologist and stalwart giant, who led the government expedition into northernmost Alaska. He has spent a dozen years tramping Alaska's wildernesses and exploring uncharted rivers. He is in field togs

The region explored by Doctor Smith and his comrades stretches for 300 miles or more along the shores of the Arctic Ocean and extends southward into the lofty and rugged peaks of the Arctic Mountains.

THE expedition attacked its objective from the south, following a plan and an itinerary that Doctor Smith worked out a dozen years ago. Once they moved from Tanana, Alaska, from whence the start was made late last February, they were entirely "on their own." They could hope for no help from those they had left behind; on their own careful preparations, their own vigilance, their own hardihood—often their own luck—the success of the expedition rested.

"Our basic supplies had to be carried from the starting-point," Doctor Smith told me. "It was essential that we should figure on complete independence. We hoped, of course, that we should find it possible to supplement our food supply by fishing and hunting, but we could not count upon it. We knew that we should see no human being from Tanana to Point Barrow, the northernmost tip of Alaska—a distance scarcely to be measured in miles, but gaged by the time between March and September.

"One item that will emphasize the required attention to detail was the carrying of strips of wood for use in repairing our canoes in case of damage. We knew that much of the country we should traverse was practically woodless, and that if repair strips were wanted, they would be wanted mighty badly. Experience showed that we were right, and the strips saved the expedition more than once.

"The supply train was a formidable procession, consisting of six teams of 15 dogs apiece, under the guidance of several whites and Indians. This train preceded the surveying party, which traveled with four additional dog teams of similar size.

"The supply train carried three or four tons of supplies. In the selection of the outfit we were compelled to give careful consideration to what should be taken and what should be omitted. An outfit may easily become unwieldy. Take, for example, the item of food for the dogs. Each animal will eat two pounds a day. For 150 dogs this means a daily consumption of 300 pounds. A team of 15 dogs

will haul from 1000 to 1500 pounds. This shows that the team will eat the equivalent of its load in from 33 to 50 days.

"YOU ask me why we did not take more men, so that it would be unnecessary for us to work like stevedores. The answer is simple. Each man involves a burden of approximately 100 pounds in the items of clothing, bedding, cooking apparatus, and general outfit, to say nothing of three pounds of food for daily ration. Each additional man easily may become a factor of weakness."

The supply train started from Tanana about the middle of February, followed a few days later by the outfit that a gentle sense of irony prompted the voyagers to designate as their arctic "passenger train."

One of the government explorers standing beside a dog sled that carried supplies for the expedition into Alaskan wilds. Smoked glasses shield his eyes from the brilliant glare of the summer sun on the arctic snow

The freight crew had been carefully instructed in the matter of the route to be followed and the system of leaving supplies along the journey for the passenger outfit. Under this well laid plan the advance party dropped a week's supply of food at every six-day interval.

The cache system worked with clocklike regularity. Wherever it was necessary for the freighters to double on their trail, leaving part of their burden for a second trip, cut branches of trees or shrubs furnished the basis and the covering for outdoor "warehouses" which protected the supplies from predatory creatures.

For the six-day intervals, however, it was deemed desirable to provide greater measure of precaution. The supplies for the passenger outfit were left suspended in trees after they had been packed in small cloth sacks inclosed in waterproofed canvas bags.

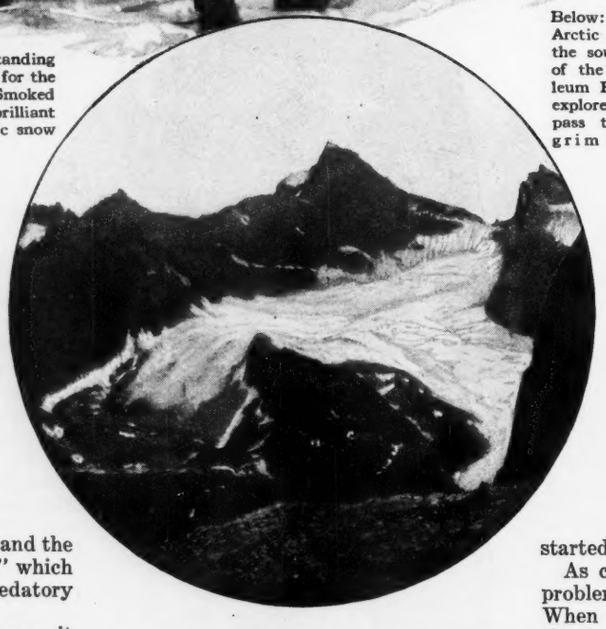
SOON after the surveying party overtook the freighters, it was found possible to make the passage toward the north by proceeding up one of the tributaries of the Alatna River. This important discovery of a pass opened new possibilities for penetrating northern Alaska, and will doubtless play its part in future development of the isolated district. The pass penetrates the mountains at an elevation of more than 3000 feet, in the midst of peaks extending as high as from 6000 to 8000 feet.

When it was determined that the freighting could be handled by the permanent organization, the freight crew was dismissed and permitted to return to Tanana.

At this point the expedition established its first base camp and began actual surveying. Old lines were picked up and the work was pushed into the Naval Reserve. The technical men carried on topographical surveying. The geologists conducted a study of the rocks, the measurement of sections, and kindred activities. In this work the members of the party traveled in groups, leaving the main camp for several days at a time.

"At times the temperature was severe," Doctor Smith told me. "To the geologists this was of little moment, for they could keep moving. To the topographers, however, it was another story. These men had to work in the open and each of them was compelled to occupy exposed positions from which he made his observations, the records of which had to be drafted with bare hands.

"I HAVE seen the engineers draw conscientiously for a few minutes at a time and then spend many minutes getting their fingers into condition to bend. Some of our trip was made in temperatures colder than 50 degrees below zero. Until May first the night temperature was always below zero."



Below: The rugged Arctic Range across the southern border of the Naval Petroleum Reserve. The explorers found a pass through these grim mountains

During the occupancy of the first base camp, active operations were conducted for moving forward into the oil reserve before the melting of the snow should make it impossible to use the dog sleds for transportation. The men not actively engaged in surveys devoted themselves to transferring supplies across the snowfields into the Colville River region, north of the mountains, where a second base camp was established somewhat later.

Late in May the snow rapidly disappeared, and by May 28 a small amount of water was running by the camp. On the last day of the month, the expedition abandoned its winter camp and started downstream in boats.

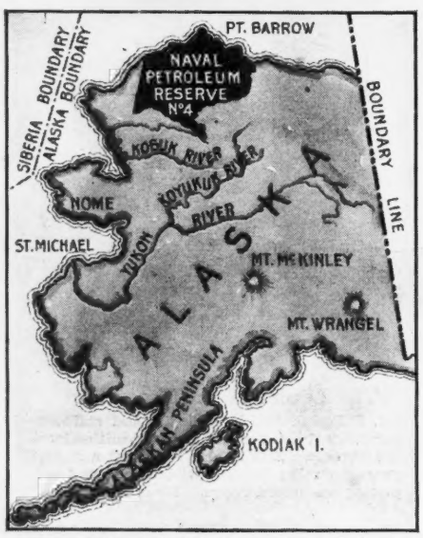
As canoeists the voyagers found their problems those of ice instead of snow. When the ice breaks in arctic streams, there is something appalling in the method of dissolution. The break comes with a mighty roar and rush. No sentry is needed to detect the opening of navigation, for the roar, Doctor Smith told me, is loud as summer thunder.

RIVER navigation at the point of embarkation offered problems of its own. For some distance the stream was extremely shallow and the men of the expedition worked their passage even more vigorously than with the passenger train of the snows. There were many places at which the boats could not be floated, and the work of dragging the craft over obstructive bars required that the voyagers wade constantly in icy waters. The experience was one to make a lasting impression.

"We were successful in keeping our heads out of the water," Doctor Smith told me; "but at times that was about all."

Fifteen miles below the winter camp the voyagers reached open water. For the purpose of covering a greater survey-

(*Continued on page 145*)

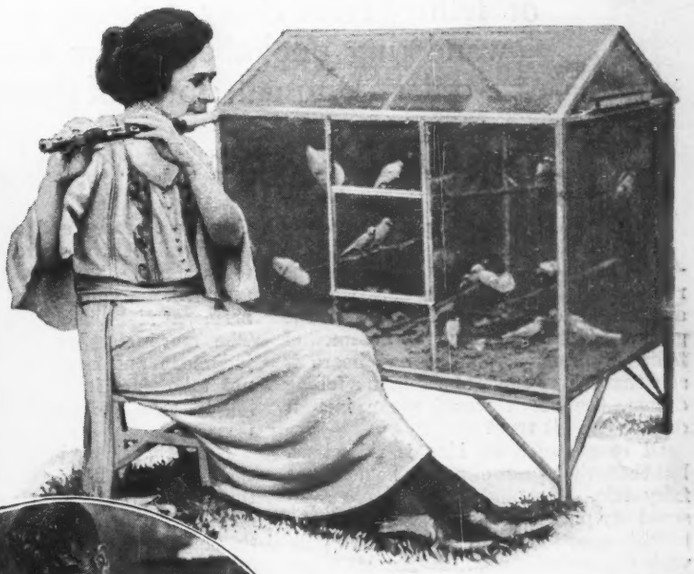


The shaded portion of this map shows the location of United States Naval Petroleum Reserve No. 4—35,000 square miles of wilderness charted and explored for minerals and oil

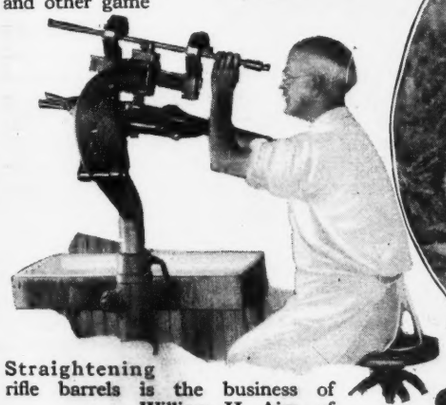
Strange Jobs of Unusual People

Here are six folks who never find their work monotonous

Jay Bruce, official mountain-lion hunter for the State of California. So far, he has bagged 206 lions, thereby saving thousands of deer and other game



Teaching canary birds to sing by playing to them on a flute is one of the occupations of Mrs. Edward Smering, of Atlanta, Ga., who conducts a bird hospital. Hundreds of birds are sent to her for treatment and training. She declares that the voices of the songsters are improved by their trying to imitate the high flute notes



Straightening rifle barrels is the business of William H. Airs, of Whitneyville, Conn. He has straightened barrels for Roosevelt and "Buffalo Bill"

Joseph Taylor, of Pipestone, Minn., is one of the few surviving Indians who knows the art of cutting stone pipe from soft, red clay

A veritable Saint Patrick is James Morris Beck of Fredericksburg, Va., who makes his living by catching snakes for circuses and museums. He has been in the business 28 years, and claims to have caught more snakes than any other man in America. While he says he fears no living reptile, he has concocted a special remedy for snake bites

All through the winter, while storms are lashing Cape Cod, Therton Crowell sits in his little shop at Dennisport, Mass., and whittles out toy windmills. Every winter he builds several thousands of them, and when spring approaches he paints them. Mr. Crowell is shown above with a number of his unusual windmill models that sell readily

What *Your Dreams* Mean

A noted authority explains the mystery of sleep—Why folks dream of falling from dizzy heights, of flying through the air, or wandering unclothed—How sleep fancies can be made to order—Unusual stories of the eight most familiar dreams

By James J. Walsh, M.D., Ph.D.

A TRAVELING salesman recently consulted me after dreaming that he had fallen 15 stories from the roof of a high office building. He had awakened just before he struck the ground. The man frequently dreamed of falling, it seemed, and he had heard it said that if ever one hit bottom in a falling dream, the shock would mean instant death. Was it true?

Of course such an idea is ridiculous, but then, thousands of people believe that fairy tale. I should like to have reassured my patient with indisputable facts, but his question could be answered only with direct testimony. If any man has died from the shock of landing at the bottom of a dream precipice, he has not had the chance to tell us about it.

My traveling man's dream was easily explained. It was nature's alarm clock to let him know that his legs were getting an insufficient supply of blood. He had eaten a heavy meal just before retiring, and the weight was pressing on the big artery over the spine, interfering slightly with the blood going to the limbs. This produced the same sensation experienced in descending in a fast elevator. Gravity being interfered with, he was catching up with the blood being pumped into his legs. The result was a feeling of being without foundation.

I ASKED him, too, about the condition of his bedsprings, for probably more than half of all falling dreams are incited by the dreamer turning over and sliding into a depression in the bed. Further, I learned that about a week previously, my patient had been watching a daredevil perform hair-raising stunts on the edge of the roof of a high office building. He had been deeply impressed by the danger of these spectacular feats. Then when he experienced the falling sensation, the thoughts recently associated with it came readily in the form of a dream.

Many persons are afraid of their dreams. Superstition has more power in this field than in almost any other. It is because human knowledge of dreams has come so slowly. For thousands of years scientists have been attempting to pry beneath the darkened glass that has obscured this mysterious function of the human mind, and even yet, they sometimes have to answer, "I do not know."

In the last 20 years we have made more progress in understanding dreams than in many centuries before. We are at last seeing possible answers to the recurring questions of mankind: "What are dreams? What causes them? What do they mean?" Our most recent and significant experiments all point toward external causes for dreams. Thought processes, it is assumed, are going on all the time in our brains, at night, as well as during the day. The more complex functions, such as judgment and reasoning, ordinarily do not take place in sleep, allowing thinking to take the form of loose associations.

Recently science has taken dreams into the laboratory in an attempt to analyze them and determine their causes. Experiments with drugs show a definite relationship between external causes and dreams. They show definitely that dreams can be made to order.

ONE physician gave a woman patient a grain a day of extract of the pituitary body to build up her blood pressure. After 10 days she began having very pleasant and satisfying dreams. Before, her dreams had been trivial, but now she began traveling to foreign lands, as she had always wanted to do. Everywhere she went, she saw beautiful landscapes in colors.

When the treatment was altered and adrenalin, another gland extract, was substituted, at once a change came over the nature of her dreams. They lost their colors and became terrifying, filled with violent quarrels.

Chemists and physicians know that in normal anger or fear the human body secretes adrenalin from the suprarenal glands. This secretion makes our hair stand on end, a cold sweat appear, and the skin look like goose flesh. The experiment I have just mentioned showed that adrenalin treatments produced the same effect in the patient's dreams. An overdose of insulin, the newly discovered gland secretion, was found to produce the same feeling of fear.

Maurey, a noted French psychologist, first suggested that a physical cause was responsible for dreams. He told of one of his own dreams as an example.

Just before going to bed he had been reading about the horrors of the French Revolution. When he fell asleep, he dreamed that he, too, was taken to the guillotine. His head was fitted on the block. Down came the gleaming, keen-edged knife, swiftly and more swiftly. Then, to his intense agony, it hit him and he woke in a cold sweat, to find that a light curtain rod had fallen and struck him squarely across the neck.

The falling rod did not just happen to hit him at the dramatic moment. The rod hit him first, he reasoned, and as this sensation penetrated his consciousness, the events about which he had been reading recently flashed into his mind. Thus it is that most, if not all, of our dreams can be traced to an external physical cause coupled with an association of ideas born of our waking experience.

EXAMINATION of thousands of dreams experienced by thousands of dreamers, has enabled us to learn that the most common dreams are eight in number. And every one of these can be traced to some physical cause.

The most common dream of all is said to be that of wandering about with insufficient clothing. In this, almost always the dreamer wakes to find that the bed-clothing has fallen from him, leaving some part of his body uncovered.

Most of us have dreamed of running after something, a trolley-car, for example.

After watching a daredevil perform hair-raising stunts high up on the cornice of a city skyscraper, a salesman acquaintance of Doctor Walsh dreamed he was falling 15 stories. In this remarkable article Doctor Walsh explains the association of ideas and the external physical causes that produced this terrifying dream that most of us have experienced either in one form or another

It is terrible, for in the dream your feet are fastened to the ground. Exerting every muscle and breathing as hard as you can, you make no progress. The car disappears in the distance. Then you wake, to find that your nose is stuffed up with cold and you are out of breath—again an actual physical sensation.

ANOTHER common dream is that of flying. Its cause is similar to that of falling. When you sleep, your diaphragm is less active and more breathing is done by the chest. Some slight interference with normal respiration causes consciousness of the chest moving up and down in quick, rhythmic movements. You have been lying in one position so long that the skin has become numb and no contact is felt with the bed. Feeling light and without contact with the earth, you dream of flying.

Since the invention of airplanes, dreams of flying have increased. Our dreams may use any material stored up in our brains. All of us have many images of airplanes and other aircraft at call. With dirigibles now soaring over our heads, dreamers will add rides in airships to their list of interesting experiences.

The dream of food, another common experience, usually can be traced to the sensation of hunger. I attach so much importance to this stimulus that when a man asks, "Why do I dream?" I often reply with the question, "When, or what did you eat?"

Ernest Shackleton, the British explorer, has told me about many of his dreams in the South Polar regions—most of them about food, all of them due to acute hunger. Once, with two companions, he was separated from the rest of his party. Each of the half starved men had three large crackers a day. They ate these slowly, reaching out after every crumb. One night, then, Shackleton dreamed that he was at the Lord Mayor's Banquet in London. All the viands for the entire meal were on the table at once, quite contrary to the usual custom. Shackleton was just ready to take the first mouthful, when he woke to find himself with a painfully empty stomach, on an iceberg in a frozen land.

AN OLD Persian legend tells of a man called Barmecide who used to torture victims, kept three days without food or water, by setting before them empty dishes and asking them to partake of the appetizing delicacies that he described. Most of those who "feast with the Barmecide" in their dreams could avoid this unpleasant experience by drinking a glass of warm milk before retiring.

Dreams of murder and death usually are traceable to indigestion. A piece of cheese has been responsible for many a nightmare. In such a dream one feels something seriously wrong, and in attempting to find an explanation for it, memory brings out from the storage house, the brain, the most terrifying images laid up there. So, too, any alteration of the blood supply to the teeth, or dental decay, may bring a dream that you are in the dentist's chair.

If, in early life, you have taken your school work seriously, you probably dream often of taking examinations. Men have told me that as much as 50 years after graduation, they have dreamed of examinations, and of being asked questions they cannot answer. This often is caused by anxiety over the next day's tasks. There is a sensation of unrest, and the dreamer, seeking some reason for it, associates it with an occasion when such uneasiness was felt—examination day at school. This type of dream is frequently experienced by doctors, lawyers, and other professional people who often are asked many questions.

THE amazing ability of the memory to produce long forgotten thoughts and images was vividly demonstrated in an experience of a friend of Samuel Butler, English novelist. This occurred in his waking hours, but it has particular bearing on dreams.

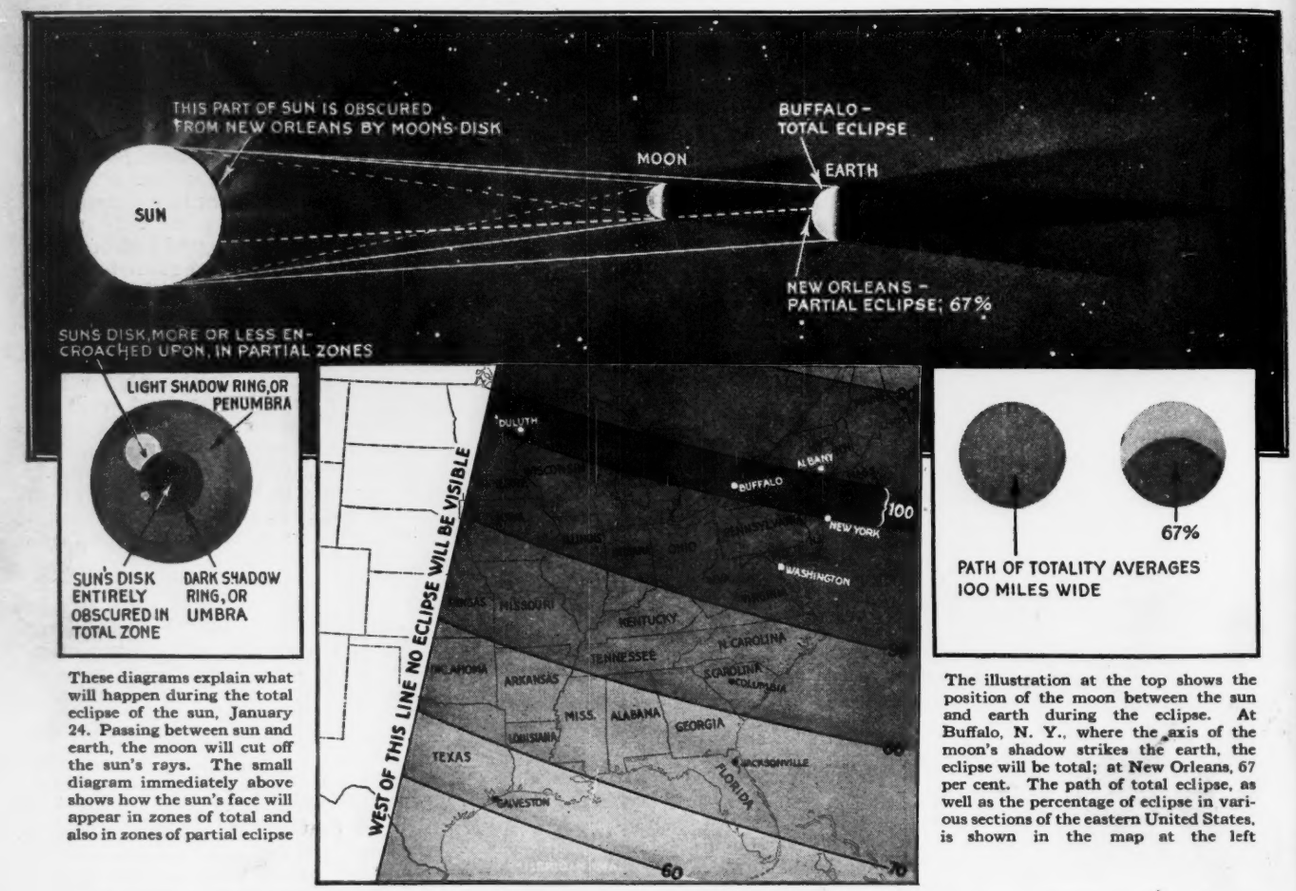
The young man, 25 years old, tore the quick of his finger on a sliver. As he felt the pain, he remembered that he had had the same sensation at another time. It was when he was seven years old. He had poked his finger in a hole in the bed, in which a bolt had once fitted, and in doing this he had hurt his finger. He remembered that at the time he had picked up a piece of paper and had stuffed it in the hole.

Then his thoughts started on a different channel. About that time a five-pound note had been lost in the house and never found. Suddenly now, 18 years later, there came the thought, "Perhaps that bit of paper I stuffed into the hole was the

(*Continued on page 150*)

The Show of Your Lifetime

To Be Seen during Total Eclipse of the Sun January 24



These diagrams explain what will happen during the total eclipse of the sun, January 24. Passing between sun and earth, the moon will cut off the sun's rays. The small diagram immediately above shows how the sun's face will appear in zones of total and also in zones of partial eclipse

The illustration at the top shows the position of the moon between the sun and earth during the eclipse. At Buffalo, N. Y., where the axis of the moon's shadow strikes the earth, the eclipse will be total; at New Orleans, 67 per cent. The path of total eclipse, as well as the percentage of eclipse in various sections of the eastern United States, is shown in the map at the left

By Henry M. Hall

IF, AT nine o'clock in the morning on Saturday, January 24, you suddenly find the light so poor that you cannot read your newspaper or go on with your work, or whatever it may be that you are doing, don't be alarmed or annoyed. Rather, consider yourself fortunate. Get out of doors as fast as you can, supplying yourself with tinted eyeglasses if you have them, and look up at the eastern sky. There, awaiting you, will be the greatest free show you probably ever will see—a total eclipse of the sun, a celestial phenomenon so infrequent that not one person in a thousand the world over sees one during a lifetime.

Indeed, total eclipses of the sun are so very limited in geographical distribution over the earth that the coming one will be the first to be visible in the parts of the United States from which it may be observed since long before the days of electric lights and automoblies.

WHAT astronomers call the "path of totality"—the places in which the sun will be entirely obscured—begins, for the coming eclipse, at sunrise in northern Minnesota, near the Canadian boundary, northwest of Duluth, with a width of about 84 miles. Sweeping southeastward, with the staggering speed of about 30 miles a minute, this great celestial pencil mark will pass over Escanaba, Mich.; Buffalo, Watkins, Binghamton and Poughkeepsie, N. Y., and New Haven, Conn. The path gradually widens, reaching a breadth of about 115 miles at Poughkeepsie.

Eclipse Time-Table

IF YOU live in or near one of the representative cities listed below, cut out this time-table for reference on January 24. It will tell you the percentage of totality where you live, and the local time at which the mid-point of the eclipse occurs. The figures are from the U. S. Naval Observatory, Washington, D. C.

Place	*Percentage of Magnitude*	*Local Time*
New Haven, Conn.	100	9.20
Ithaca, N. Y.	100	9.04
Poughkeepsie, N. Y.	100	9.16
New York, N. Y.	100	9.15
Buffalo, N. Y.	100	8.51
Syracuse, N. Y.	99	9.07
Albany, N. Y.	99	9.18
Cambridge, Mass.	99	9.32
Philadelphia, Pa.	98	9.07
Cleveland, Ohio	97	8.37
Urbana, Ill.	91	8.02
Des Moines, Iowa	90	7.38
Topeka, Kan.	83	7.26
Atlanta, Ga.	80	8.12
Oklahoma City, Okla.	74	7.14
Jackson, Miss.	72	7.43
Austin, Tex.	61	7.07

THESE cities are all close to the center line of the shadowy ribbon. So, if you live within, say, from 30 to 40 miles north or south of a line drawn through them on the map, you can see the eclipse if you wish, and if the weather is clear.

Sweeping across Connecticut, the path will pass over the Atlantic, maintaining the same general direction until it reaches about latitude 40° N., longitude 55° W., where it will attain its greatest width, and change to a northeasterly direction, sweeping up over the North Atlantic until it loses itself at sunset about halfway between Iceland and the Scandinavian peninsula.

A word about eclipses in general; then let us picture what you will see if you are fortunate enough to be in the path of the coming eclipse.

An eclipse is simply a more or less complete darkening of the face of the sun or of the moon. The first is caused by the passage of the moon between the sun and the earth; the second by the passing of the earth between the sun and the moon. Because the ever-changing relative positions of the sun, moon, and earth recur in a strictly periodic or cyclical manner, the

(*Continued on page 146*)

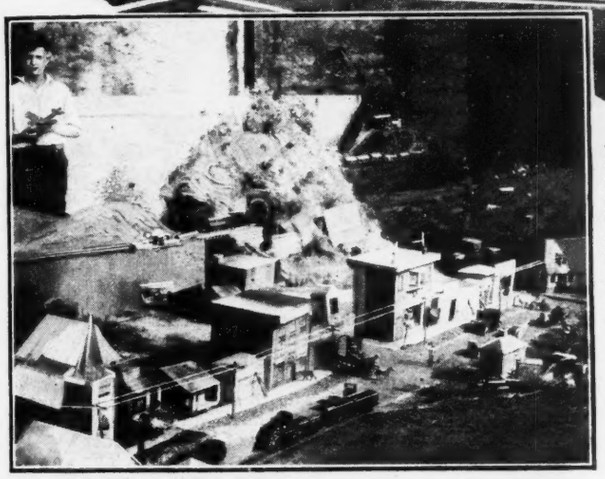
These Boys Are Expert Mechanics

Amazing Products Prove Youthful Skill in the Workshop

NEVER before have children received such thorough training in mechanics as they do in the schools today. Almost by the time they are out of kindergarten they are learning how to use simple tools such as the fretsaw, and this education progresses through the higher grades.

Yet the boys of today, not content with school training, are establishing their own workshops at home. Here they are doing amazing things in mechanical construction and invention, as shown by the pictures on this page.

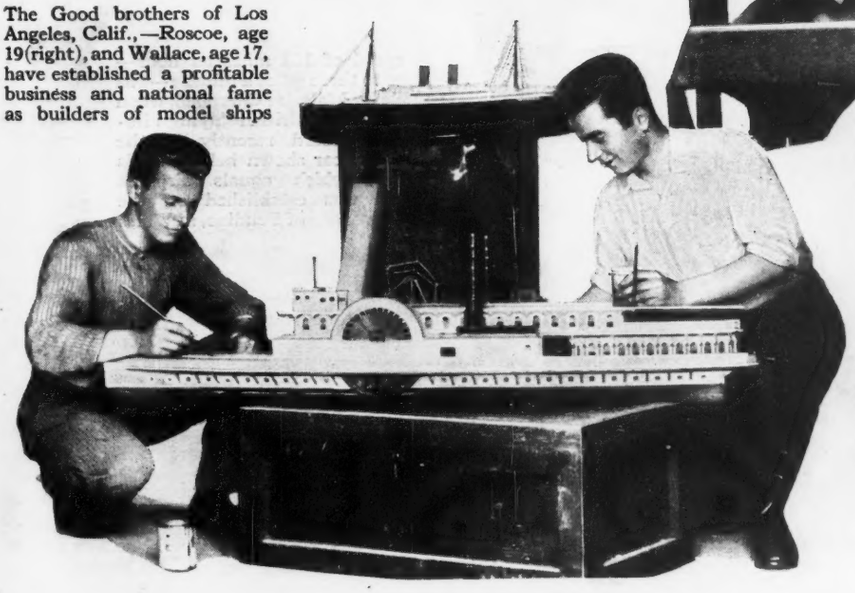
For example, there is Stanley Eintracht, a 17-year-old inventor of east London, England, who employs eight men in his own workshop. He is shown at the right with one of his latest inventions—a radio set contained in a model of "Felix the Cat." Another of his inventions is an ingenious "mother's alarm" that will ring whenever the baby cries.



At the left is a model town, complete even to telephone lines, built by Glenn MacElroy, age 12, in his back yard at Cincinnati, Ohio. He made the buildings all of cardboard

At the age of 11, Kelvin Vanderlip 2d, son of Frank A. Vanderlip, New York financier, is an expert in the use of carpenter tools, the lathe and circular saw. He is shown below operating a bench saw

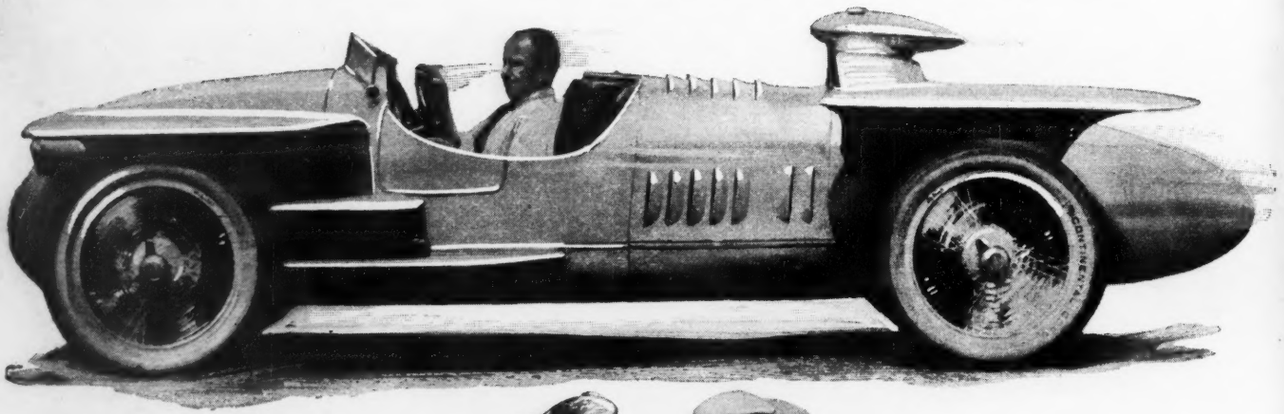
The Good brothers of Los Angeles, Calif.,—Roscoe, age 19(right), and Wallace, age 17, have established a profitable business and national fame as builders of model ships



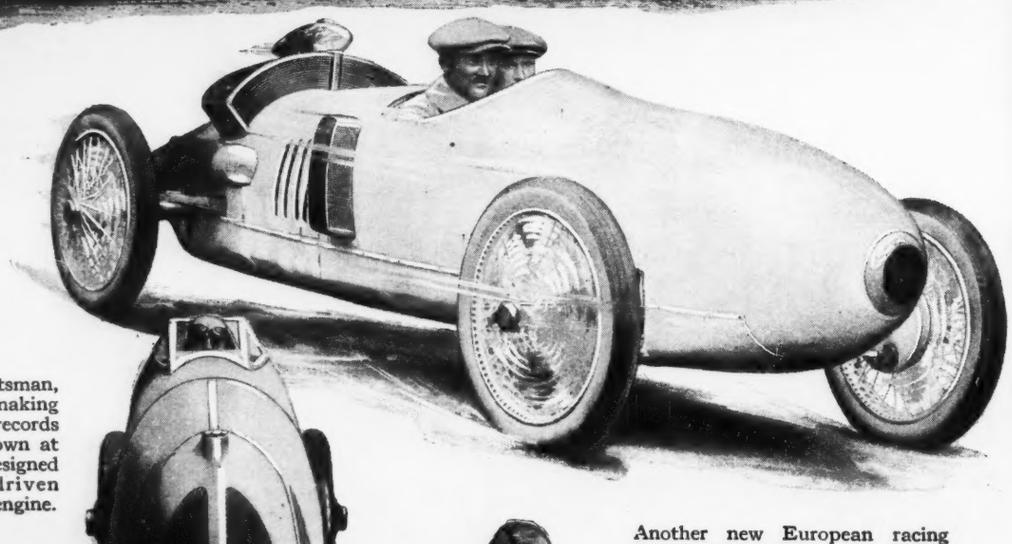
Louis Cantenot of Dijon, France, is an expert astronomer at the age of 14. He has made many remarkable instruments, including his telescope

Newest Marvels of the Speedway

Rear Motor Machines Designed to Split the Air



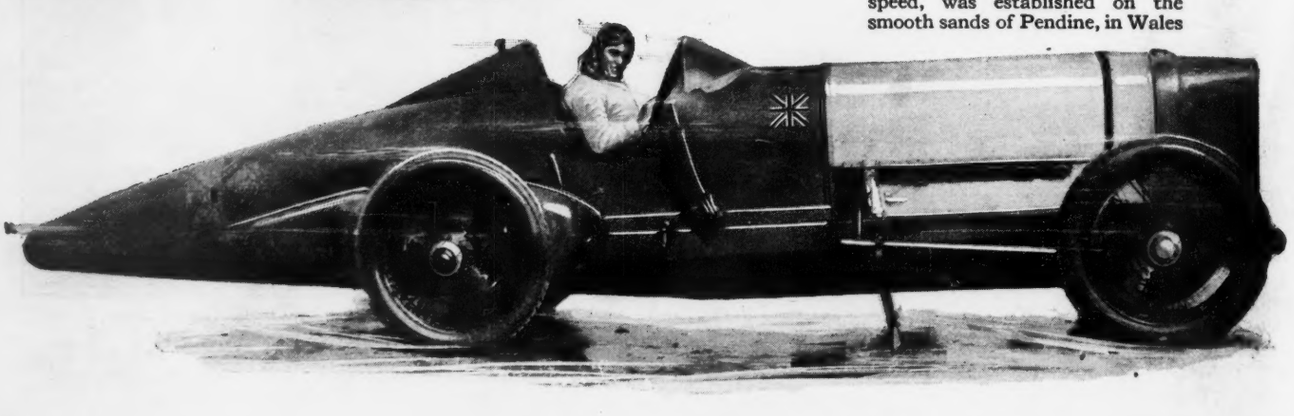
"The cart before the horse" well describes one of the most recent of European speed creations (above). For in this car the power unit, including engine, clutch, gearbox, differential and radiator, is located at the rear, while the seats for driver and mechanician are near the front, between the axle centers



An Egyptian sportsman, Prince Djelaleddin, is making a bid for world speed records with the machine shown at the right. This car, designed by the prince, is driven by an eight-cylinder engine.

Another new European racing model with power plant and radiator at the rear. This small, bullet-shaped car, of German make, is said to attain a speed of 116 miles an hour, although the cylinder volume of its six-cylinder engine is less than a Ford's. The maximum engine speed is more than 5000 revolutions a minute

A speed of 168 miles an hour—close to three miles a minute—was made by Malcolm Campbell, when he broke the British "flying kilometer" record recently in the powerful car shown below. This record, which equals airplane speed, was established on the smooth sands of Pendine, in Wales



The Atom's Amazing Secret of Power near Solution?

Efforts under Way to Unloose Limitless Stores of Energy

By G. B. Seybold

IN A laboratory in Sheffield, England, a scientist is working on what may be the most dangerous experiment in the world—in an effort to release the tremendous power locked in the atom.

Apprehension is felt by the country folk about; there is an attitude of tense watchfulness and hidden dread. The experimenter stands by an electrical apparatus, reaches out, and turns a switch.

For many months Dr. T. F. Wall, noted engineer of Sheffield University, has been doing this. He is attempting to disrupt the atom and release its energy by means of an extremely powerful magnetic field.

Some day, possibly at a terrible moment, the great current of electricity which he is loosing through that simple motion, may accomplish the end toward which he is working. The result no man can prophesy.

Will there be a gigantic shock, a blinding flash, swallowing everything? The destruction of the world? Will the terrific energy of a single atom be communicated to adjoining atoms until the world, the stars, the whole universe are reduced to electricity? One instantaneous whiff of energy released with a terrifying detonation, and after that—nothing?

Or will that moment be a quiet one, with a man standing there motionless, awed by the realization that he has discovered the greatest secret of all ages—a method for releasing and controlling the gigantic forces believed to be imprisoned in the atom.

MOST of those working with the atom today offer reassurances. There will be no cataclysm, they say. As man learns how to release the atom's energy for his own use, he will learn, also, how to control it. But the mere fact that *no one knows* is enough to explain in some degree the fears some people express.

Consider a body so minute that 6,000,000 like it could rest on the point of a needle. This is the atom—the atom that scientists are tearing to pieces and hope to find alive with power beyond human conception.

In a pint of water there is enough of this mysterious power to drive the *Leviathan* across the Atlantic and back!

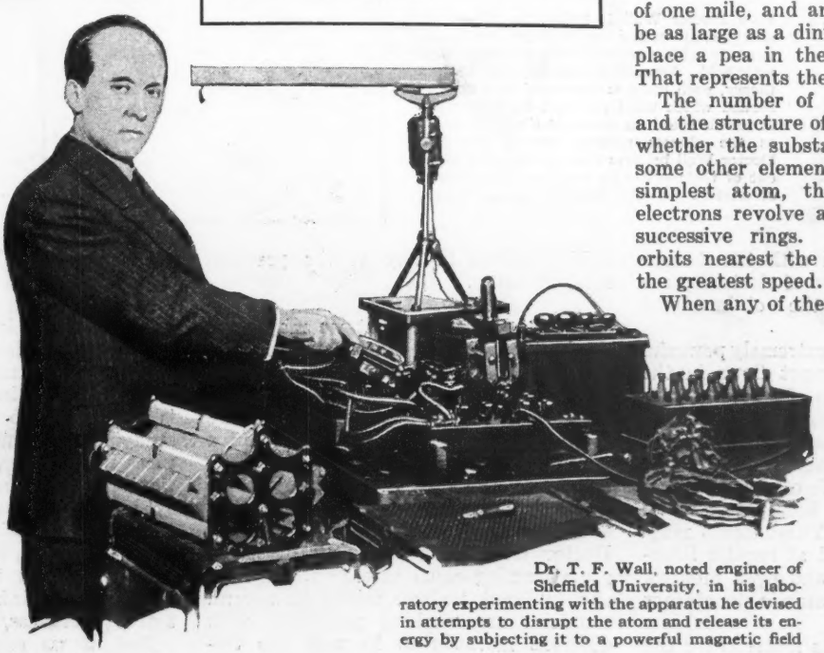
World's Greatest Riddle

THE United States Bureau of Standards recently asserted that the most outstanding scientific accomplishment of the decade is the exploration of the atom.

Atoms are at once the smallest and most wonderful things in the world. Everything in the universe is made of them. They are so small that 6,000,000 of them could sit on the point of a needle.

Yet many scientists believe that each tiny atom is literally alive with power beyond human conception. There is energy enough in atoms, they say, to run the wheels of the world. Other investigators are less credulous, believing that atomic energy is found only in radioactive substances and will be forever out of the reach of man.

In nearly every part of the world men are exploring the atom, seeking to capture and harness its tremendous power.



Dr. T. F. Wall, noted engineer of Sheffield University, in his laboratory experimenting with the apparatus he devised in attempts to disrupt the atom and release its energy by subjecting it to a powerful magnetic field

A child could hold in the palm of its hand a metal brick containing enough explosive energy to blow up Los Angeles! In an ordinary motor-truck could be carried enough concentrated energy to level half a nation!

But this force, so tremendously destructive, could also be the greatest benefactor of mankind. Enough of it to run the machinery of the world indefinitely. Enough in a chunk of mud to run an automobile for weeks! A vast untapped force to make coal, oil, and all other existing sources of energy obsolete! Enough to do the work of the world, to change civilization on this earth!

The modern view is that everything in our universe, including ourselves, is made up of atoms, each comprising a nucleus with a number of electrons whirling about it in fixed orbits, just as planets revolve about the sun, at a tremendous rate of speed, as great as 93,000 miles a second.

No one ever has seen an atom, and no one ever will, for we see only by means of light, and the atom is so small that it escapes detection by the vibration of light waves. No microscope, no matter how powerful, ever can help us. If a drop of water were magnified to the size of the earth, an atom in the liquid would appear the size of a baseball. Consider the Yale Bowl an atom, and an electron speeding in it would be the size of a gnat.

THE nucleus is still smaller than an electron. Give the atom a diameter of one mile, and an electron in it would be as large as a dining-room table. Then place a pea in the center of the table. That represents the nucleus.

The number of electrons in an atom and the structure of its nucleus determine whether the substance is gold, iron, or some other element. In all except the simplest atom, that of hydrogen, the electrons revolve around the nucleus in successive rings. Those traveling in orbits nearest the nucleus revolve with the greatest speed.

When any of these electrons are forced out of their pathways, dragged farther away from the nucleus, a great amount of energy is released. Some of the energy of motion that the fast whirling electron had in its own orbit is lost when the electron jumps, and this lost energy is released in the form of waves. If the nucleus of an atom can be attacked and destroyed, the whole atom can be disrupted, causing the electrons to be shot out of their orbits.

This actually can be seen in the case of radium by a remarkable instrument that photographs what is happening in the

interior of an atom. As particles flying from radium pass through a gas, they electrify atoms in their path, and small drops of moisture forming on these make a trail of mist, which can be photographed. Thus, though the atom itself will forever remain invisible, its travels can be observed readily.

THIS photographic apparatus has revealed that a radium atom behaves just like any other atom for one or two thousand years—its electrons traveling in fixed orbits around a nucleus—then suddenly it explodes, throwing off a new atom, that of the gas, helium. And in this process, when the particles are being shot off at high speed, the radium is being changed into lead. Transmutation of matter is taking place.

The high speed electrons in the atom, explains Doctor Wall, are like electric currents, and produce in the atom intense magnetic fields of such immense strength that hitherto it has been impossible to produce anything as great by artificial means. But, if it were possible to produce a magnetic field as powerful as those in the atom, and this field were impressed on the atom, he argues, the orbits of the electrons would be so disturbed that the structure of the atom would be broken down, and some, or all, of its energy would be released.

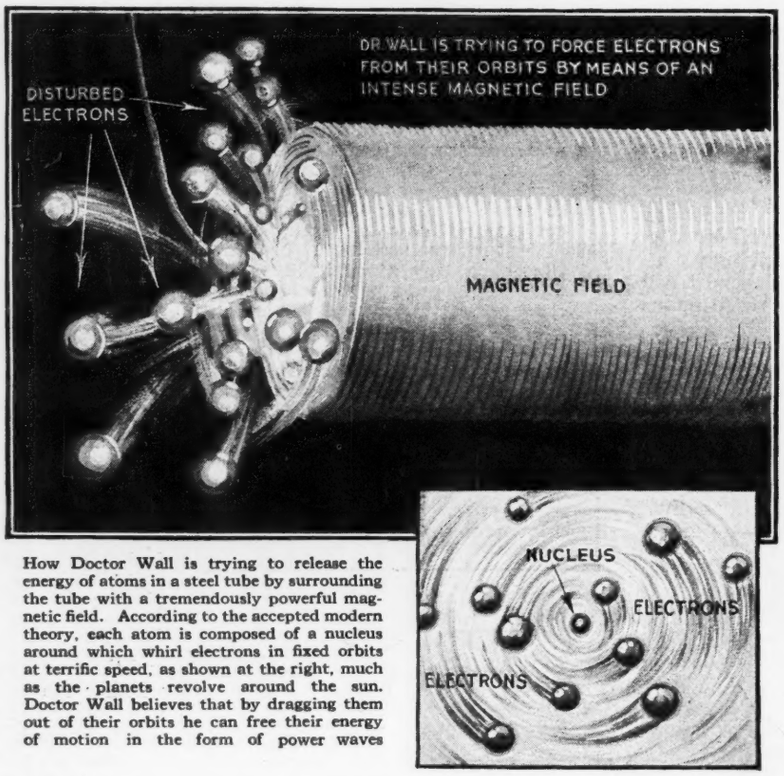
Doctor Wall has obtained a magnetic field 20 times more intense than any ever known before, by winding several layers of thick insulated copper wire around a small tube of steel. This is immersed in a large glass tank filled with transformer oil, and huge quantities of electricity are discharged through the oil-immersed copper.

The result is that an extremely powerful oscillating electric current flows in the coil for a small fraction of a second, producing a correspondingly intense magnetic field, which passes through the steel tube. For a minute fraction of a second, the apparatus is capable of permitting an equivalent of 200,000 horsepower to be supplied to the coil. This intense magnetic field is impressed at regular intervals for days, weeks, and even months, on the material whose atomic structure it is desired to change.

Steel was used as the material for the first test, because it was discovered that any change in the positions of electrons in the atoms of steel, alters the magnetism of the metal, either weakening or strengthening it, thus forming a valuable guide to what is going on. As an incidental result of this experiment, a way may be found to improve definitely the inherent magnetic qualities of iron and steel, which, in itself, would be of tremendous importance industrially.

So far as Doctor Wall's work has progressed, a remarkable phenomenon has been observed. At some stages the discharge current in the coil around the piece of steel increases to an enormously greater value than would be expected from calculations. An instability of current is being reached, which means that the strength of the magnetic field is increasing beyond all expectations. With a further increase of power, the strength may go on increasing without limit, until the dramatic moment arrives when the atom is shattered.

Doctor Wall now is modifying his apparatus so that it is expected to give at least twice the strength of magnetic field obtained in any of the previous measurements.


DR. WALL IS TRYING TO FORCE ELECTRONS FROM THEIR ORBITS BY MEANS OF AN INTENSE MAGNETIC FIELD
DISTURBED ELECTRONS
MAGNETIC FIELD
NUCLEUS
ELECTRONS
ELECTRONS

How Doctor Wall is trying to release the energy of atoms in a steel tube by surrounding the tube with a tremendously powerful magnetic field. According to the accepted modern theory, each atom is composed of a nucleus around which whirl electrons in fixed orbits at terrific speed, as shown at the right, much as the planets revolve around the sun. Doctor Wall believes that by dragging them out of their orbits he can free their energy of motion in the form of power waves

IT IS conceivable that we may learn shortly how to get at the power that some day will enable us to hold the engine of a motor-car in one hand. Instead of the tons of coal we buy every winter, we may release the energy contained in a two-pound lump, knowing that there is enough there to heat a large house at a comfortable temperature all winter.

Great as is the interest in the efforts of Doctor Wall, the experiments of others are attracting equal attention. In fact, one hundred trained minds in several countries are working patiently, with different methods to harness this tremendous power. To one or the other of their laboratories may come success at any moment.

Scientists working in America agree with Doctor Wall that it will take some tremendous force, something much greater than anything we now have, to disrupt the atom. While the English scientist is trying to pull electrons out of their orbits by producing a great magnetic field, Dr. Gerald L. Wendt of the Physics and Chemistry Department of Pennsylvania State College is attempting to do the same thing with heat. In his experiments he is using a temperature of 60,000° F., which is six times as hot as the heat of the sun, and 20,000 degrees hotter than the hottest star. This is obtained by using 100,000 volts of electricity.

The American scientist places a tungsten wire in a vacuum tube through which he shoots energy, in the hope that more energy will come out than went in, and that the tungsten will be transformed into helium.

Transmutation of metals is seen to be linked closely with the problem of how to release atomic energy. For when one element is changed into another, according to the theory of modern science, it means that one or more electrons have been added to or subtracted from each of its atoms. And when this happens, the electrons moving into their new orbits release energy.

INTENSE heat was responsible for the reported transmutation of mercury into gold recently by Professor Miethe, of Germany. By subjecting quicksilver to tremendous heat in an electric furnace, one of the 80 electrons in the quicksilver atom was dislodged, he explained, leaving a nucleus surrounded by 79 electrons, which is the structure of the gold atom. When this electron was forced from its orbit, energy was released.

Recent experiments of Doctor Nagaoka of Tokio University, Japan, who is said to have succeeded also in obtaining gold from mercury, are being watched closely by those trying to learn how to release atomic energy.

Dr. Robert Andrews Millikan, the distinguished American explorer of the atom, is attempting to discover the secret by studying the tremendous changes taking place in the stars, where physical conditions often transcend those of earth.

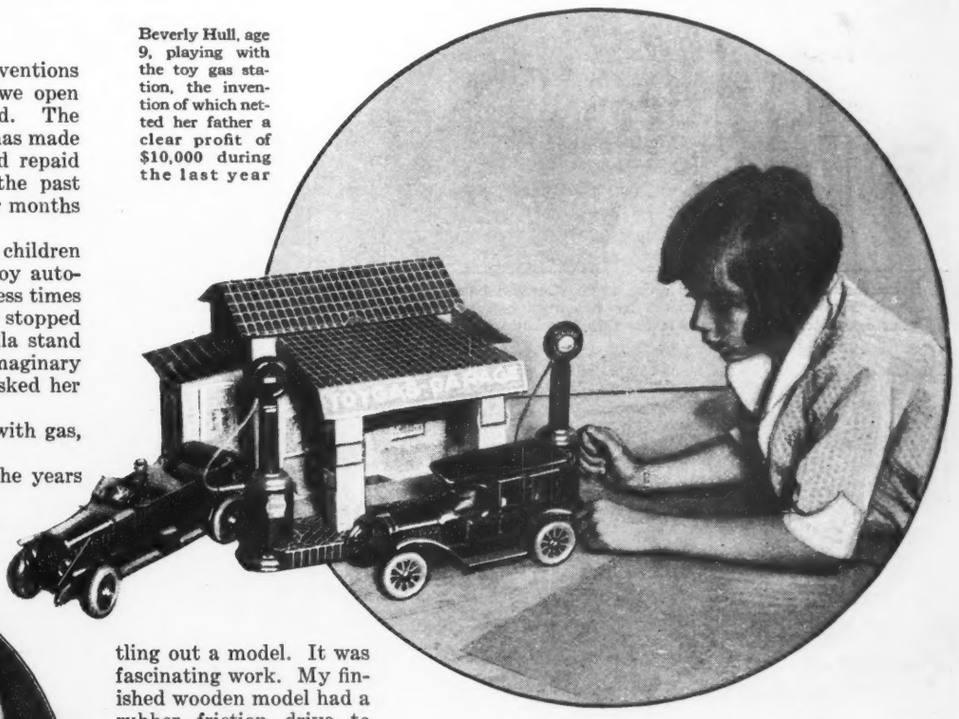
Sir Ernest Rutherford, President of the British Association for the Advancement of Science, doubts that great stores of energy exist in every element, but believes that this is true only in the radioactive substances, radium and thorium.

But, if we could find some way to quicken the exploding process going on in radioactive substances, so that the whole cycle of their disintegration could be confined to a few days instead of being spread over thousands of millions of years, Sir Ernest thinks that these elements would be valuable sources of energy.

An Idea Worth $10,000

How a Child's Play Developed a Profitable Invention

By Roger B. Hull



Beverly Hull, age 9, playing with the toy gas station, the invention of which netted her father a clear profit of $10,000 during the last year

IDEAS for money-making inventions are not hard to find when we open our eyes and look around. The working idea for a new toy that has made me a clear profit of $10,000 and repaid the entire cash investment in the past year, was right under my feet for months before I saw it.

One Sunday afternoon my children were playing on the floor with toy automobiles, as they had done countless times before. When my little daughter stopped her "yellow taxi" at the umbrella stand and stood there turning an imaginary crank, out of sheer curiosity I asked her what she was doing.

"Why, I'm filling my car up with gas, daddy."

A toy filling station! In all the years that automobiles—touring-cars, trucks, taxis, and busses—have been furnishing models for popular toys, no one had ever realized the possibilities of a miniature filling station. Immediately I saw how it would add to the delight in toy autos to have somewhere to run them and something to do when they got there.

Roger B. Hull is a Wall Street attorney by profession. But the invention that he began as a pastime has grown to a business of such proportions that he has had to establish separate offices to handle it. In a year, more than 2,000,000 of his toy gas stations have been distributed by chain stores

It was a good idea; I was confident of that. But I never possessed any pronounced mechanical bent. Besides, I was busy with my law practice, and turning the thought of a toy gas station over in my mind occasionally was as far as I got for two years.

Then one winter I began spending my evenings whittling out a model. It was fascinating work. My finished wooden model had a rubber friction drive to run the gas indicator up and down, and was equipped with a rubber hose. The shaft of the crank projected slightly from the side, and clicked against a bit of steel as it turned, thus providing the necessary noise. I had discovered that a toy must have action, noise, and imagination to capture a child's interest. But I still knew so little about the cost of materials that in working for a cheap toy, I had built an expensive one.

In my spare time I called upon toy manufacturers and asked them to recommend a practical mechanic who could help me put my wooden model into materials that would make it practicable for production as a cheap toy for big distribution.

In this way I eventually found a mechanic who had been a toy manufacturer. Together we devised a new mechanism using a ratchet wheel and pinion, and he made the dies for a tin model.

The toy filling station as perfected for the market (left), and the first wooden model that Mr. Hull made by hand

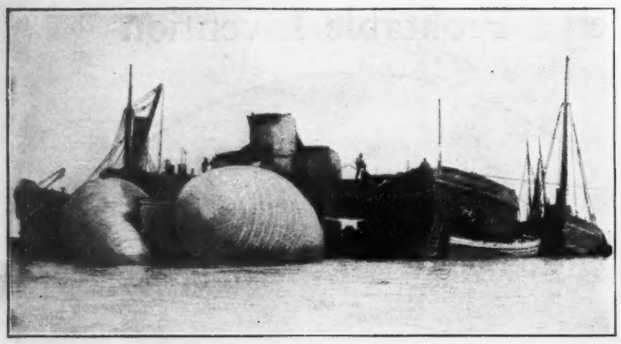
The first tin gas station looked splendid in comparison with my crude whittling, but it ran too well. There was no noise. Our problem finally was solved by placing the indicator on a tiny "washboard" that moves up and down as the crank turns. Making the ratchet wheel and pinion movement loose enough to let this corrugated tin strip slip a little with each turn of the crank produces the desired racket. Then, as a "safety" feature, we added a spring to hold up this strip, so that the child can turn on and on without injury to the toy. When the crank is reversed and the indicator goes down, the spring gives the same protection at the bottom.

FINDING a cheap substitute for the rubber hose line presented considerable difficulty. But twine, with a tin ferrule on the end to give the impression of a hollow interior, finally was adopted as the next best thing for a 10-cent toy.

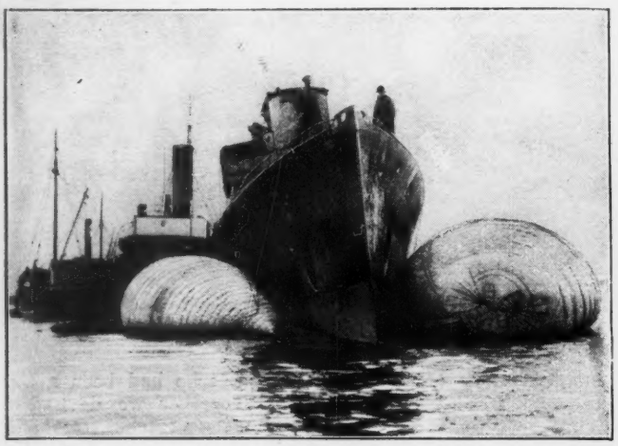
I first offered this novelty to the large refining companies as an advertising medium. They were skeptical. So I went to see the toy buyer of one of the largest chain-store corporations in the country. And I may add that I haven't needed to worry about distribution since. From the moment he saw that little gas station, he knew it would sell.

The idea I picked up off the floor already has grown into an incorporated concern for the toy station and other novel playthings suggested by the games of my children and their playmates.

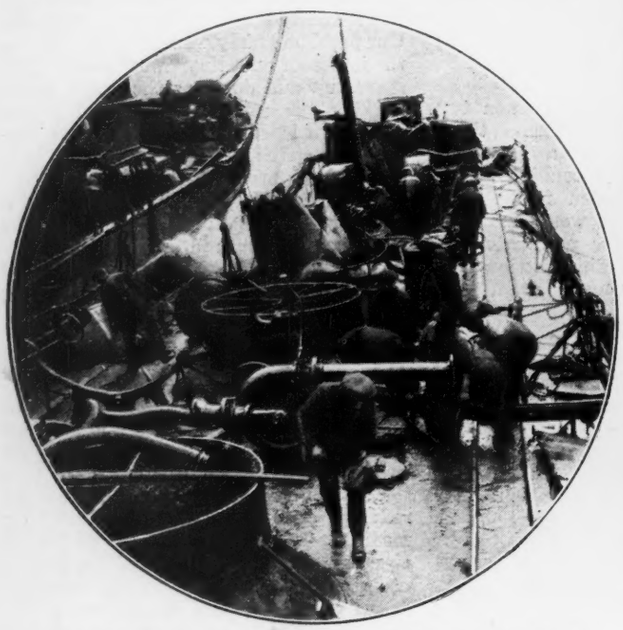
Huge "Water Wings" Float



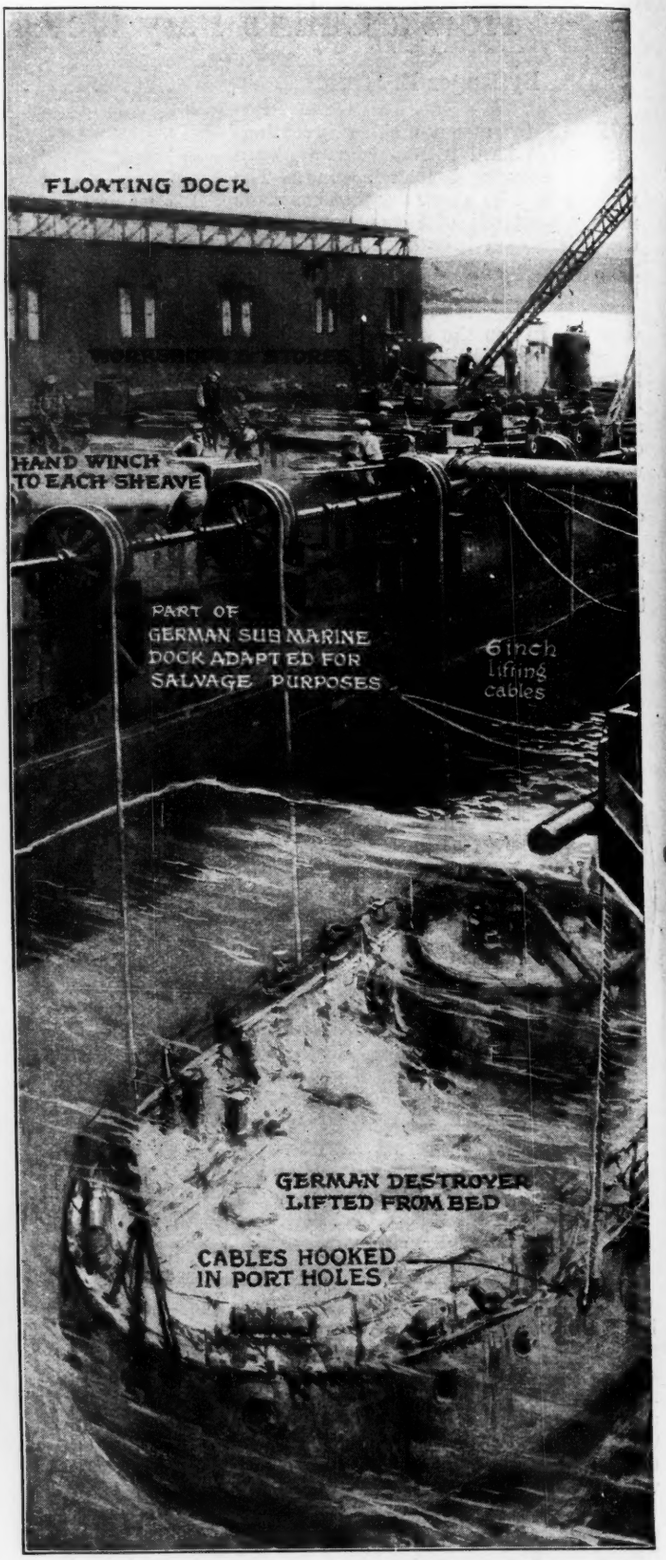
Resurrected from the watery grave of the German battle fleet in Scapa Flow—a destroyer floated by two huge balloon pontoons that are fastened to the bow of the ship, one balloon on each side



Lifted and held afloat by mammoth "water wings," the weed-covered destroyer is towed ashore to be broken up and sold as scrap. Each of the balloon pontoons is capable of lifting 150 tons



Cheating Davy Jones. This photograph shows a salvage crew removing heavy fittings, turrets, and guns from the dilapidated decks of one of the German destroyers raised after five years in the sea


FLOATING DOCK
HAND WINCH TO EACH SHEAVE
PART OF GERMAN SUBMARINE DOCK ADAPTED FOR SALVAGE PURPOSES
6 inch lifting cables
GERMAN DESTROYER LIFTED FROM BED
CABLES HOOKED IN PORT HOLES

How the scuttled destroyers are raised by cables from two halves of a surrendered German submarine-testing dock. Lifting cables hooked into portholes of the sunken ship are manipulated by hand winches operated by balanced teams of men on each side of the dock

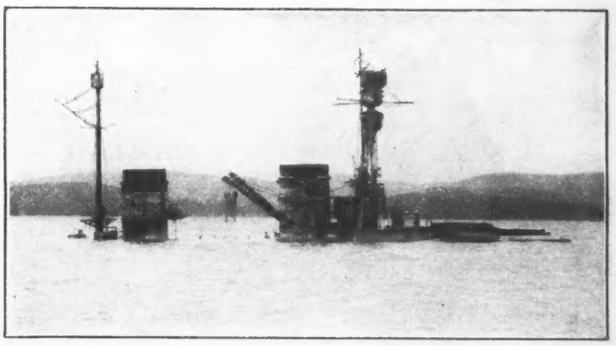
FACING constant danger and thrilling adventure in the murky depths of a naval graveyard, the crews of a salvaging company are engaged in raising the surrendered German battle fleet that was scuttled by its own crews at Scapa Flow, north of Scotland, on June 21, 1919.

Of 51 war-ships sent to the bottom, the salvaging company purchased from the British Admiralty 24 destroyers and the two great battle cruisers *Hindenburg* and *Seydlitz*.

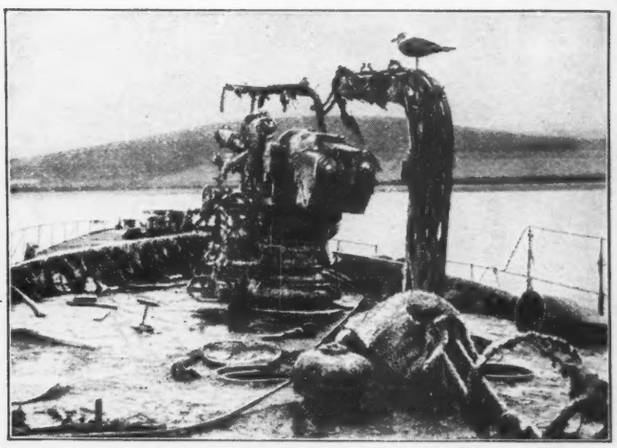
The illustrations on these pages show the spectacular methods by which Davy Jones already has been cheated of a number of Ger-

Scuttled German War-Ships

In the first attempt to raise the destroyer V-70 by this method the heavy cables snapped under the weight of the destroyer and the tons of water in which it was sunk, their broken links raking the decks of the pontoons and endangering limbs and lives of the workmen



One of the greatest tasks is that of raising the battle cruiser *Hindenburg*, which rests upright on a sandy bottom in 60 feet of water, its turrets and funnels above water and its decks awash at low tide



The foredeck of the German destroyer S-131 after five years' immersion, showing gun incrusted with marine growths. Note the solitary seagull standing on one leg on a dilapidated davit

This immense chain cable was snapped as easily as a daisy chain by the tremendous dead weight of a sunken destroyer. The man in this weird picture is exhibiting one of the cleanly broken off links

man destroyers, including the S-131, the V-70, and the S-53. By one method huge balloon pontoons are deflated, submerged, and attached to the sunken ship. Then the air is pumped into the odd caterpillar-like bags, which lift the vessel slowly to the surface.

A second method, pictured in the center illustration, utilizes a reconstructed submarine-testing dock surrendered by Germany as a basis for lifting operations with cables and winches.

The floating of the battle cruisers *Hindenburg* and *Seydlitz* probably will be attempted next spring by closing all sea inlets of the sunken ships and pumping out the water.

Crime Mysteries Bared by the Microscope

Sherlock Holmes Outdone by New Science

Dr. Edmond Locard, director of the police technical laboratory, Lyons, France, and his microscopic camera which has solved some of the most baffling mysteries

Amazing stories of how a modern detective, armed with an instrument that magnifies 50,000 times, finds murder clues even in specks of telltale dust

By Truman Stevens

IN THE office of the Prefect of Police in Toulon, France, not long ago, sat a man suspected of counterfeiting. Half a dozen police officers were questioning him closely, but his glib answers, apparently made with the utmost frankness, were plausible enough to be quite disarming.

True, he admitted, he had served a prison term for counterfeiting, but he had learned his lesson and reformed. He was now law-abiding, satisfied to earn a meager living in his café in Marseilles. More than five years had passed since last he had seen a printing press or an engraver's tool. How, then, could the police suspect him of any part in preparing the spurious 100-franc notes with which the section had been flooded?

Vainly the police sought to make him confess. The man denied everything, and at last the prefect gave a sign that the questioning was at an end.

"Before you depart, though," he said to the man, "our physician will examine you. Merely a little precaution in the interest of public health."

Happy that he had carried off his part so successfully, the man submitted willingly to the perfunctory examination by the physician; then departed after bidding his inquisitors an extravagant farewell and expressing the hope that they would be successful in catching the counterfeiter.

The man got his wish, for two days later the police called at his café and again took him in custody, and this time his protestations of innocence availed him nothing. For the police had evidence that eventually resulted in his conviction. He himself had unwittingly supplied it during the physical examination, in a tiny specimen of wax which the physician had taken from his ear!

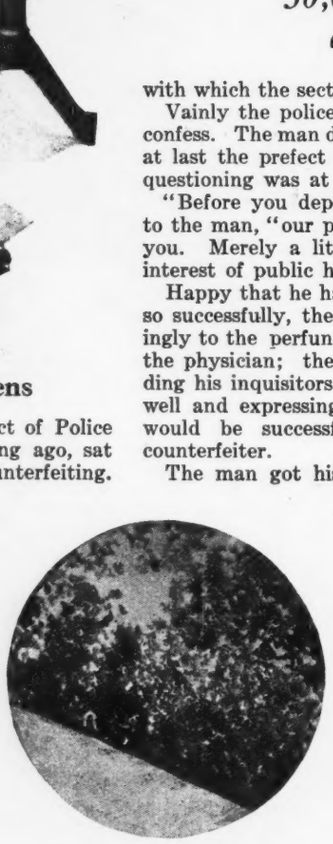
THIS bit of wax had been forwarded to Dr. Edmond Locard, director of the police technical laboratory at Lyons, who had photographically enlarged it with his microscopic camera, a device of his own invention, which has proved of incalculable aid to the police in unraveling some of the most mysterious crimes that have occurred recently in France.

Magnified 225 diameters, or more than 50,000 times, the speck of wax showed telltale streaks of printer's ink, particles of dust readily identified as from a lithographic stone, and traces of characteristic crystals of a chemical used by engravers, undeniable evidence that the prisoner's story was a fabrication.

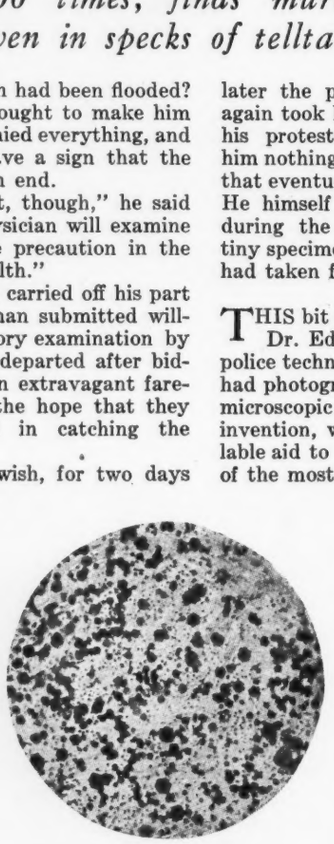
And this was only a single instance of the amazing uses to which the Locard microscope recently has been put in the detection of crime.

Centuries ago it was considered good police practice

(*Continued on page 147*)



Particles of iron, chemical crystals, and dust in a speck of wax taken from the ear of a suspected counterfeiter and magnified 50,000 times by the super-microscope. This photograph was accepted and used as important evidence in the man's trial



Magnified 50,000 times, a speck of dust beaten from the clothing of a Parisian suspected of counterfeiting nickel one-franc pieces revealed these nickel alloy shavings. This evidence led to conviction after he had offered a most convincing alibi

How to Build a House that Will Save Half Your Coal

Surprising new tests show that with an inexpensive overcoat frame walls resist cold as does 16-inch brick

By Newton Burke

THIS winter the people of America will waste not less than $100,000,000 trying to heat their homes, this amount representing by a conservative estimate the value of about 8,000,000 tons of coal that experts say will have been shoveled unnecessarily into American furnaces or stoves.

This reckless extravagance means an actual loss in dollars and cents to every one in the country, for you share in the waste, whether you buy coal to burn in your own furnace, or help defray the needlessly large coal bill of your landlord in the form of rent.

Most persons who stoke a furnace through the winter—their own or somebody else's—learn to use coal economically. Also, the average home heating plant is not only efficient, but literally foolproof. Whence, then, comes this appalling waste, amounting virtually to half the domestic fuel bill of the nation?

RECENT scientific investigations, which uncovered the waste, place the blame on the wholly unscientific methods employed in constructing most of our dwelling houses. The average dwelling, the investigators assert, is so built that only between 40 and 50 per cent of the heat of the coal consumed in its furnace is utilized to make the house comfortable for its inhabitants. The rest is lost in leakage through walls and roofs—particularly the latter—and this condition of unscientific construction involves practically every type of house, from the modest bungalow to the big apartment house or hotel.

The investigators have determined, among other things, that at slight additional expense—the cost of one winter's coal supply in the average case—a house can be so constructed that the cost of heating will be cut in half.

The secret lies in supplying insulation for the walls and roof; heat-resistant materials, such as cork, sawdust, or wool, which will prevent the furnace heat from escaping outward, and conversely also will keep the hot rays of the sun from making the house overwarm in summer.

It has been determined that a house of good frame construction, with a single inch of efficient heat-insulating material in its walls, will be protected from the cold of winter and the heat of summer as effectively as though its walls were of brick 16 inches thick or of concrete 26 inches thick! Moreover, such a house will save its occupants money in coal, not only because it will require less fuel to operate the furnace, but because a fire need not be started so early in autumn, nor be kept going so late in spring.

The heat of the sun, too, can readily be called into service as an auxiliary furnace for a properly insulated house with consequent saving of coal. Indeed, one investigator, James Govan, an architect and inspector of hospitals for the Ontario Government, states without reservation that under proper conditions, the sun alone can be used to heat a house comfortably through the whole winter! This, he declares, can be accomplished by placing the house with full exposure and an abundance of windows to the south and supplying adequate protection against heat losses on the other sides and in the roof.

That this amazing suggestion is entirely practical I can testify from personal experience. Last winter I called on a friend who had just moved into a new home in Washington, D. C. The heating plant had not yet been installed, and yet the house was warm merely from the sun. Moreover, my friend and his family occupied the house without discomfort during a whole week of severe weather until the furnace was ready. This house, of course, was insulated against heat losses and had adequate storm sash and weather stripping.

A Felt-Lined Overcoat for the Home

Insulating the walls of a frame house by placing a lining of asbestos felt between the sheathing and shingles. Recent scientific investigation shows that a house of good frame construction, with a single inch of efficient heat insulating material in its walls, will be protected from winter cold and summer heat as effectively as if its walls were of brick 16 inches thick, or of concrete 26 inches thick. A house so insulated, tests show, may reduce the winter coal bill 50 per cent and shorten the furnace-using season for you

INDEPENDENT investigation of the subject of heat conservation through insulation has so established its importance that recently a central committee was formed under the auspices of the National Research Council to investigate fully every phase of the question. Serving on the committee are chemists, physicists and engineers representing the United States Bureau of Mines, the Bureau of Standards, the engineering departments of Harvard University and the University of Michigan, as well as large industrial organizations.

Through the work of this committee the findings of previous investigators undoubtedly will be crystallized and standard construction methods pointing the way for the American householder to cut his yearly coal bill in half, will be worked out for various types of houses.

Meanwhile, though, let us see what scientists already have found out.

Both walls and roofs have been found responsible for the escape of heat, especially the roofs, because warm air rises. Evidence of this is found in the rapidity with which snow melts on the average housetop even in severe weather.

The old theory that a dead air space between walls is sufficient to prevent the escape of heat has been disproved. The investigators found, on the contrary, that hollow wall construction aids the escape of heat through convection—that is,

movement of the heated air in the wall spaces, the hollow construction supplying a sort of chimney through which the hot air rises as rapidly as it is supplied by the heating plant.

THE way to utilize dead air spaces in walls scientifically is to break them up so that, instead of having one great hollow wall extending from cellar to attic, you have a very large number of tiny dead air spaces separated by heat-resistant materials, preventing the warm air from traveling from one to the next. The simplest and most economical way to supply these is to pack the hollows between walls tightly with wood wool, pure wool, mineral wool, hair felt, cork board, rock cork, or various manufactured products that can be utilized for the purpose.

A wide variety of materials is available, the only requirements being that they be poor conductors of heat, unlikely to become breeding places for germs and vermin, and easy to handle. Since most heat-stopping materials are little more than refuse, they can be purchased cheaply. This is why the investigators say that any house under construction can be insulated effectively for a cost not exceeding half of one year's coal bill.

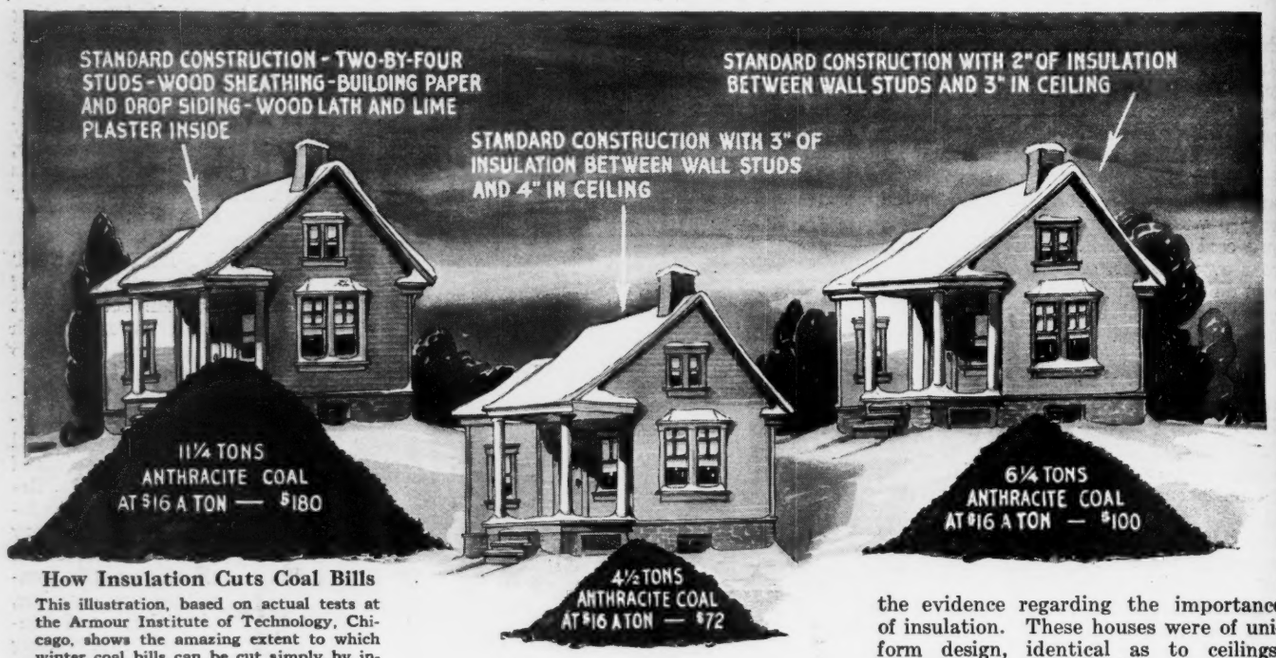
However, insulating the walls alone will not suffice. It has been determined by scientific test that in a house with walls insulated by four inches of mineral wool and its roof protected only slightly, the saving of heat effected by wall protection is largely offset by the loss of heat through the roof.

Even though both walls and roof are insulated, loose windows, poor workmanship in installing windows and doors, and lack of weather stripping and storm windows may cause leakage sufficient to make heavy inroads on the coal supply. Failure to apply wall sheathing, and the use of green lumber, which in drying opens cracks in the plaster and works out of place, likewise may undo the good done by insulation.

In a well insulated house, equipped with storm sash and weather stripping, covering the furnace pipes with asbestos effects a further saving in fuel.

The foregoing may be taken as the high points of the several investigations of the insulation question conducted in this country, Canada and Norway. Specific instances of the experiments through which these results were achieved are even more significant.

Professor James T. Peebles, of the Armour Institute of Technology, Chicago, studied in the laboratory the problem of heating a detached bungalow, 26 by 32 feet, with a 10-foot ceiling, through 200 days with an average outdoor temperature of 33 degrees. For 16 hours each day 70 degrees was to be maintained within, and 55 degrees during eight hours' sleeping time.


STANDARD CONSTRUCTION - TWO-BY-FOUR STUDS - WOOD SHEATHING - BUILDING PAPER AND DROP SIDING - WOOD LATH AND LIME PLASTER INSIDE
STANDARD CONSTRUCTION WITH 3" OF INSULATION BETWEEN WALL STUDS AND 4" IN CEILING
STANDARD CONSTRUCTION WITH 2" OF INSULATION BETWEEN WALL STUDS AND 3" IN CEILING
11¼ TONS ANTHRACITE COAL AT $16 A TON — $180
4½ TONS ANTHRACITE COAL AT $16 A TON — $72
6¼ TONS ANTHRACITE COAL AT $16 A TON — $100

How Insulation Cuts Coal Bills

This illustration, based on actual tests at the Armour Institute of Technology, Chicago, shows the amazing extent to which winter coal bills can be cut simply by insulating the walls of a frame house of standard construction. Three inches of wall insulation and four inches in the ceiling reduced the winter coal consumption from 11¼ to 4½ tons, a difference in cost between $180 and $72, or a saving of 60 per cent

THE first house was built of two-by-four studs, with walls of wood sheathing, building paper, and drop siding, and with wood lath and lime plaster inside. The ceiling construction was wood lath and lime plaster on the lower side of wood ceiling joists. Single windows were used, and there was no attic flooring. With this construction, which is recognized as standard, 11¼ tons of anthracite coal at a cost of $180 were required to heat the house.

With the addition of two inches of insulation between wall studs, and three inches in the ceiling, only 6¼ tons of coal were required, the cost dropping to $100, while with three inches of wall insulation and four inches in the ceiling, the coal consumption was only 4½ tons and the coal bill only $72, the price of coal being $16 a ton.

Quite as remarkable results were achieved in a study of a brick house of the same size and plan. Three inches of insulation in the side walls and four in the ceiling resulted in reducing the yearly coal bill from $117.50 to $49.60.

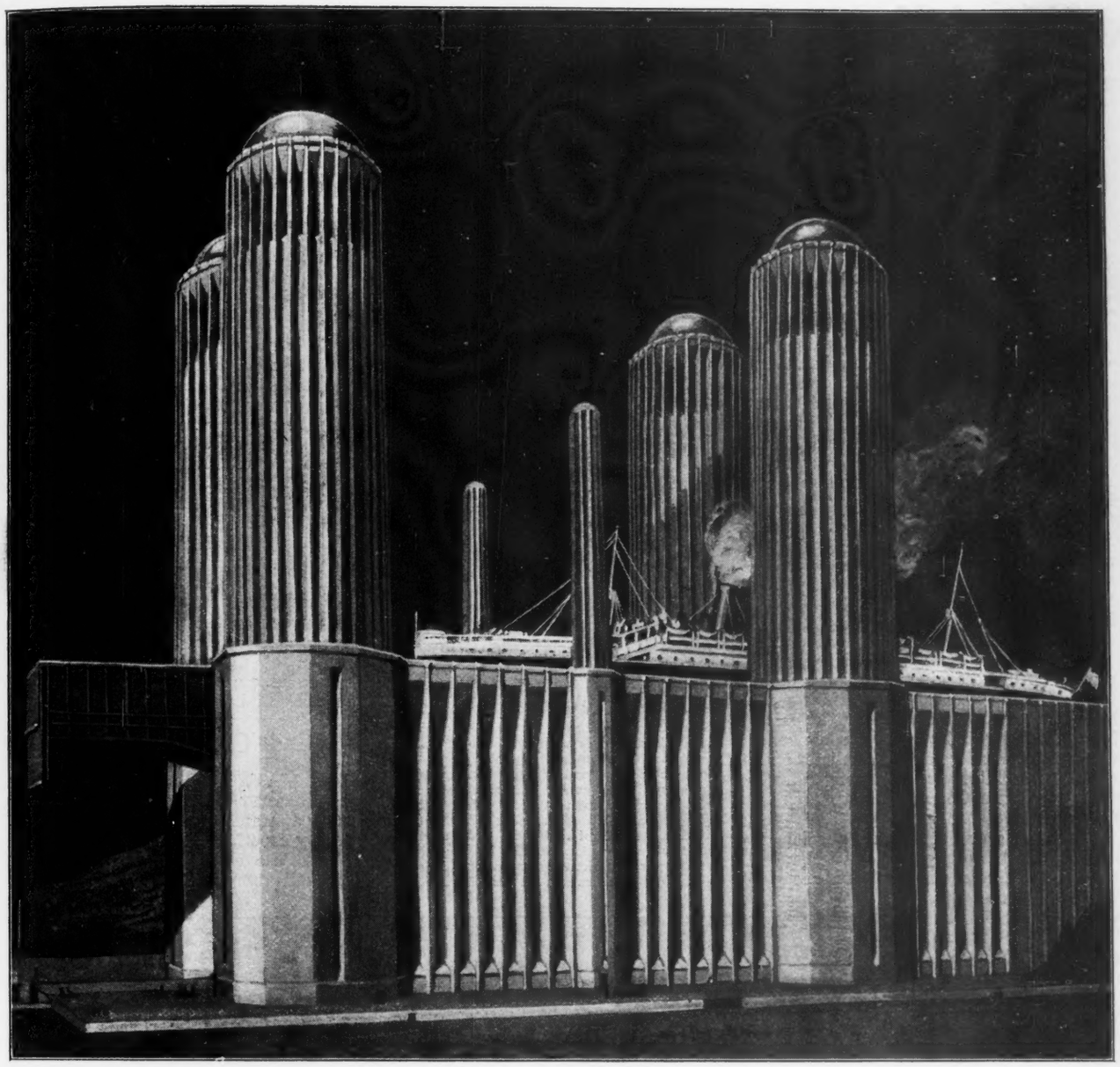
Recent tests performed by scientists of the United States Bureau of Standards yielded results equally amazing. In these tests standard types of wall construction were reproduced in the laboratory, and their heat-resistant qualities determined. Here, too, it was demonstrated that properly installed heat-resistant materials in the walls and roofs of dwellings will enable the owner to reduce his annual fuel bills by 50 per cent or more.

A TWO-YEAR test of 27 small houses sponsored by the Norwegian government and completed recently added to the evidence regarding the importance of insulation. These houses were of uniform design, identical as to ceilings, floors, doors and windows. The only variation was in the type of walls. A single electric heating plant served them all in regulated quantities.

A frame house, containing heat insulation in the form of a four-inch layer of sawdust covered with a single sheet of asphalt pasteboard, made the best score in economy of heat and retention of heat, despite the fact that other houses were of brick, cement block, reinforced concrete and similar sturdy construction. This test also demonstrated the amazing fact that a frame house, properly insulated, is heated more efficiently and economically than a brick house, according to conclusions drawn by Prof. Andrew Bugge, of the Norwegian Technical University.

Professor F. B. Rowley, of the University of Minnesota, is another who has demonstrated that heat loss is reduced by insulation. One-half inch of insulating material placed between the studding of a wall constructed with inside plaster, sheathing, tar paper, and drop siding, Professor Rowley reports, will effect a saving of 26 per cent in heat loss.

You would search in vain for a bank that would give you a mortgage on your home at four per cent. Yet the saving on your coal bill that you can effect through insulation of your home easily may represent the difference between a rate of six per cent and four per cent on a mortgage.



Goliath of Locks for Ship Canal

Mammoth Water-Towers to Lift 25,000-Ton Vessels

By Fritz Blocki

THE simple principle of physics that causes air bubbles to rise to the surface of water has been applied in the design of a mammoth new type of lock for lifting ships of large tonnage from one level to another in a canal. The photograph above shows a model of the new invention, which attracted much attention at a recent technical exhibition in Berlin, Germany. It is the work of George Ollert, inventor, and Hans Rottmayer, architect, both of Berlin, and was designed for use in the Welland Ship Canal between Lake Erie and Lake Ontario. Two of the locks, they calculate, would take the place of the series of locks now in operation in the canal.

The invention is designed to lift vessels of 25,000 tons, in addition to the 60,000 tons representing the weight of the water-filled trough or basin that holds the ship, and of all movable parts of the lifting mechanism.

Each of the four large towers shown in the picture are filled with water, and at the top of each is a giant air-filled float supported by the water. Extending downward from the four floats are four rods suspending two cross beams that support the large steel lifting trough. This trough has gates at each end.

The arrangement is such that the pressure of the water on the floats in the towers exactly balances the combined weight of the water-filled trough and the ship. Thus the trough really acts as a cradle floating on the water contained in the four towers.

On each side of the lock, between the large water-towers, you will observe a smaller tower. Both small towers are used for the actual lifting process. Each contains a piston connected at the lower end with a cross beam supporting the lifting trough in the middle.

Since the ship, resting in its floating cradle, is held in suspension, lifting the load is accomplished simply by forcing compressed air against the pistons in the central towers. Lowering is accomplished in a similar manner.

Of the two locks designed for the Welland Canal, one would be capable of lifting a ship 131 feet; the other to a height of 207 feet. The structures would be of reinforced concrete. The larger one would be 688 feet long and 574 feet high.

Artificial Sunlight to Make Weak Children Strong

Secrets of health found in violet rays—The X-ray for everyday jobs—Other important new developments in science

As A result of amazing experiments recently completed at the University of Maine, scientists believe there has been put in their hands a means of controlling the dread bone disease, rickets, the chief cause of bow legs and of other more serious deformities of the limbs from which children suffer.

These experiments, conducted by Dr. C. C. Little, president of the university, and Dr. W. T. Bovie, professor of biophysics at the Harvard Medical School, in cooperation with the General Electric Company, were performed on a flock of 233 chicks. They demonstrate the importance of sunlight in human health, particularly as a factor in the physical development of young children.

The chicks were divided into three groups. All were given the same diet, but one group was kept in natural sunlight, the second in natural sunlight passing through window-glass, while the third was kept in natural sunlight and exposed at intervals to strong ultra-violet rays from Cooper-Hewitt lamps of fused quartz.

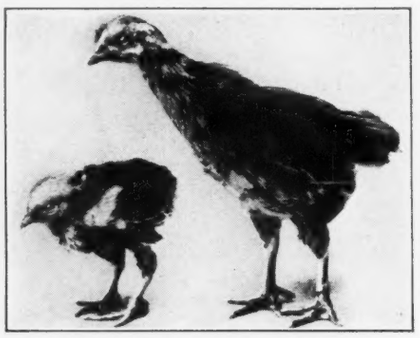
The first group of chicks developed normally. All of the second group—those that received the sunlight through window-glass — developed rickets. Those of the third group in 10 weeks reached the same stage of physical development that those raised in natural sunlight only attained in 12 weeks.

The conclusion drawn from the experiments is that the ultra-violet rays of the sun exert a most tremendous influence on bone growth. This is amply substantiated by the larger growth of the chicks that received direct application of the ultra-violet rays, and by the development of rickets by the chicks raised under window-glass, which screens out the ultra-violet rays of the sun. Further evidence was supplied by the fact that the rickety chicks were speedily cured when subjected to ultra-violet ray treatment. And science, of course, seeks to apply the results of the experiments to the prevention and cure of rickets in children.

Science also sees in the results of the experiment an explanation of the fact, long known, that between 97 and 100 per cent of the children born in the summer and autumn develop rickets in some degree by the following spring. Through the winter the mothers of recently born children fear to subject them to the bitter cold; hence, the babies receive their "sunshine" in glass-inclosed porches, or from behind closed windows.

That more children are not crippled permanently by rickets from this cause is due to the fact that the beneficial effects of ultra-violet rays on the growth of the bones are apparent almost immediately when children kept indoors during the winter are subjected to the direct rays of the sun. It makes no difference what portion of the body receives the sunlight; the effect of the rays is transmitted through the whole body.

Fused quartz does not absorb the ultra-violet rays. It is so expensive to produce at present, though, that it is unlikely it will soon find general use as a substitute for window-glass, even for a purpose so important as the prevention of rickets. It is in the cure of rickets through application of ultra-violet rays, artificially produced, that science hopes the experiments will bear greatest fruit.

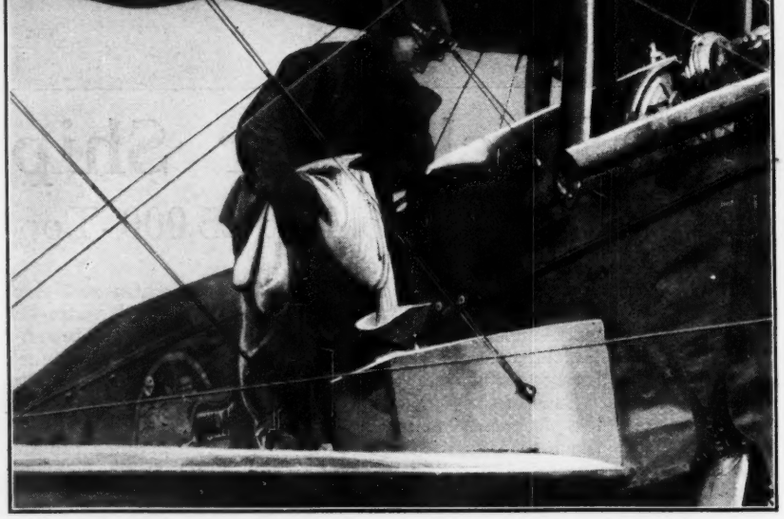


The Weak and the Strong

This photograph shows the amazing effect of ultra-violet rays on the growth of young chickens. Both chicks are four weeks old, from the same brood and raised under identical conditions, except that the larger and healthier chick was treated 15 minutes daily with ultra-violet rays. The small chick lived under natural sunlight filtered through window-glass, which eliminated the ultra-violet rays. Babies deprived of outdoor sunlight, experimenters say, are similarly affected

Blast Clouds with Sand

IN MAY, 1923, POPULAR SCIENCE MONTHLY announced the success of early attempts to produce rain and dispel fog by shooting electrified sand from airplanes into clouds, forecasting the commercialization of the process for the benefit of mankind. A few weeks ago the first public application of the scientific rain-making process since its announcement in this magazine was made at Bolling Field near Washington, D. C. Two planes, piloted by Capt. A. I. Eagle and Lieut. W. E. Melville, succeeded in "shooting down" a series of overshadowing clouds.



Capt. A. I. Eagle of the U. S. Army Air Service, filling a tank on his plane with sand preparatory to the recent rainmaking tests at Bolling Field, Va., when aviators succeeded in entirely dispelling a series of clouds by blasting them with electrified sand

The process used was that described a year ago last May. It was worked out by Dr. Wilder D. Bancroft, professor of physical chemistry at Cornell University, and L. Francis Warren. Mr. Warren describes the process briefly thus:

"We fill sand tanks on the planes with 120-mesh silica sand, the planes being equipped for charging the sand either positively or negatively by the turn of a lever. The sand, impinging upon the charging plates or falling through charging nozzles, is scattered by

the air and driven back by the propeller.

"When a cloud is found to have a positive charge, we scatter negative particles at the extreme top, and *vice versa*."

The "Crazy Gas" Scare

TETRAETHYL-LEAD fumes, or "crazy" gas, which was declared responsible for the deaths of five workmen at the Standard Oil Company manufacturing plant at Bayway, N. J., recently, has aroused a storm of controversy. Besides the fatalities, 36 men were taken to the hospital for treatment, several showing symptoms of insanity. The Standard Oil Company has discontinued manufacture of the compound temporarily.

Chemists have known tetraethyl, a compound of lead and alcohol, since 1854, but the discovery of its value as an anti-knock compound for automobile gasoline is recent. It is diluted with 1000 parts of gasoline, the final product sold being known as ethyl gas.

The extent of danger involved in the compound falls under three divisions: Danger in the manufacture of tetraethyl lead; danger in handling it, and danger in using it. In the manufacturing process, it is handled in concentrated form. It is sold in pure form to garages and filling stations, where it is then added to the gasoline. Any hazard to the consumer would come in inhaling the exhaust of engines using it.

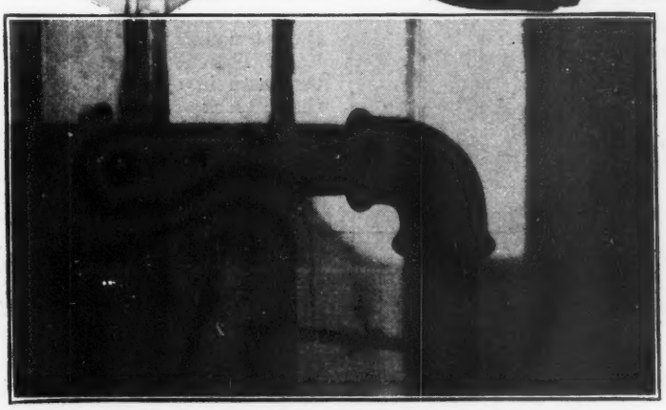
The Federal Bureau of Mines is investigating all three classes, but has announced its conclusion only on the last. As a result of 10 months' investigation of the effect of the gas on various types of animals, it reports that the danger to the public from breathing lead in the exhaust of automobiles is "seemingly remote."

Dr. Yandell Henderson, professor of applied psychology at Yale, one of the greatest authorities on the action of gases on the human body, disagrees with this. It is not only very dangerous when handled in concentrated form, he says, but the exhaust of ethyl gas diffused through the streets, offers a grave public menace. If a woman cleans her gloves in ethyl gas, she may be poisoned, made insane, or killed, he asserts.

Dr. E. E. Smith, of New York City, a toxicologist of 40 years' experience, says that tetraethyl-lead gas is a menace only in large industrial plants. Thomas Midgely, Jr., who discovered the process of making the compound, testified that he had worked with it for two years without suffering any harm.

Looking through Walls

How the new portable X-ray equipment is used by workmen to locate pipes and wires within a house wall



Remarkable X-ray of a wall, revealing elbow in pipe and nails

X-Rays Put to New Uses

UNDOUBTEDLY you have seen a plumber poking blindly into a clogged pipe seeking the cause of a stoppage, or an electrician "fishing" for a wire through a hole in a wall where he intends to install an outlet. Such haphazard operations are necessary no longer. Neither need builders trust to their instinct in seeking the location of a floor beam, nor must jewelers make guesses in determining the genuineness of precious stones. For there was devised recently in the laboratory of the General Electric Company in Schenectady, N. Y., a practicable, portable X-ray apparatus, that weighs only 20 pounds and is operated merely by plugging into an ordinarly electric-light switch.

The new device was developed by Dr. W. D. Coolidge, inventor of the Coolidge X-ray tube, and is designed expressly for practical use by workers in trades that ordinarily do not employ the X-ray. It is equally adaptable to emergency or permanent use in the scientific laboratory, or by the busy physician or dentist.

The new X-ray machine is carried complete in a leather-covered wooden container, seven by eight by 10 inches, about the size of a one-tube radio set, which in appearance it somewhat resembles.

U. S. Leads in Telephones

JUSTIFIABLE pride may be felt by the American who considers the latest statistics of the telephone industry. The United States wins the international telephone championship by possessing 63 per cent of the telephones in the world. European countries have less than half that number—26 per cent, while the remaining 11 per cent are found outside of Europe and the United States.

Omaha, Neb., leads the world with 28 telephones to each 100 persons. The next 10 cities are, in order: Stockholm, Sweden, San Francisco, Minneapolis, Denver, Washington, Los Angeles, Chicago, Toronto, Cincinnati and New York. Paris, France, appears twenty-third in the list, and London twenty-fourth.

The airplane hanging between two houses after crashing into the one at the right

Plane Crashes into House and Hangs from Roofs

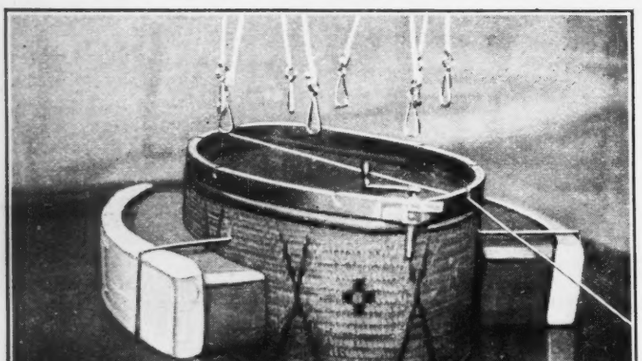
EVER since an airplane with pilot and one passenger recently crashed into the front porch and upper story of his home, Ralph Sweigart, of Dayton, Ohio, has wished that he did not live quite so close to the McCook Flying Field. Both of the fliers were seriously hurt and much damage was done to the frame building, as well as to the plane.

After the crash the plane hung suspended between the house it had struck and the roof of the house next door.

Safety Basket for Balloons Stays Afloat

A FLOATING basket for balloons has been invented to lessen two of the greatest dangers encountered in balloon accidents. Most aeronauts who have lost their lives by drowning, have done so either because the basket of the balloon sank, or became entangled with ropes leading to the gas bag.

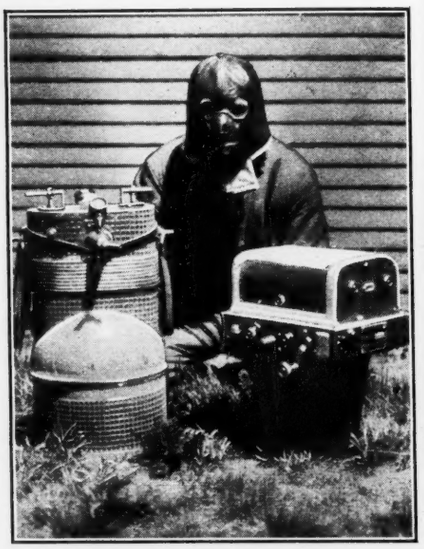
In the new invention two airtight chambers, having great carrying capacity, are attached to the outer wall of the basket. When not in use these are compressed like a folding camera and held in that position by a rope. If the balloon falls into water, the aeronaut need only cut the rope and the chambers are expanded by inrushing air. The chambers are reinforced by strong spiral springs.



The balloon basket with floats attached, and showing safety releases

The other unique feature of the invention is the ease with which the ropes leading to the net may be released. These ropes terminate in eyes that lock in catches around the upper edge of the basket rim. When a lever is turned, the catches are released so that the ropes all can escape at the same time, and thus avoid any tangling.

Aerial Photographers Wear Oxygen Masks



FOR taking map pictures miles above the earth, Uncle Sam recently has equipped his aerial photographers with the elaborate apparatus shown above.

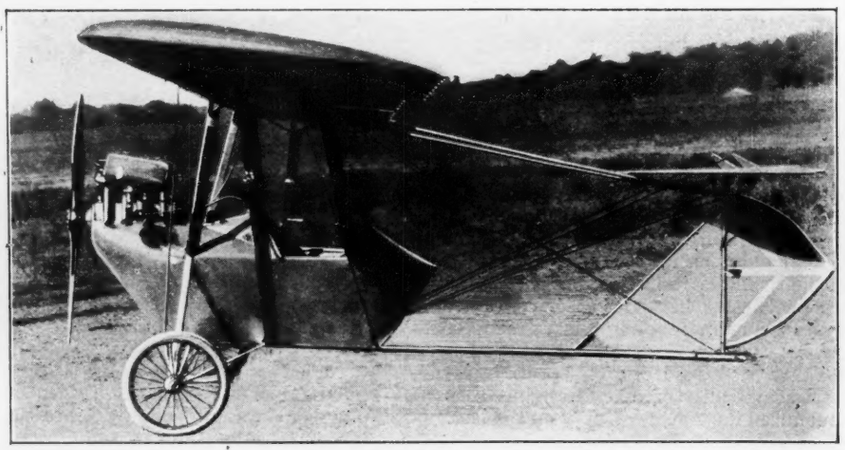
At the left is the equipment that supplies oxygen to photographer and flier in the rarefied atmosphere above about 20,000 feet. At the right is the latest type of aerial camera that has proved capable of taking remarkably clear photographs of the earth from an altitude of nearly six miles.

Odd "Flying Bathtub" Airplane Wins Race and Climbs 2500 Feet

THE "Flying Bathtub" is the appropriate name given to an odd looking craft that recently won the Rickenbacker race for light planes. Ever since it was first flown to the McCook Field at Dayton, Ohio, by its designer, Etienne Dormoy, a technical engineer, it has attracted much attention.

The body of the monoplane, which resembles a tub, is connected with the tail piece by rods and wires. The absence of a fuselage gives the plane its appearance of extreme frailty.

Twenty-four feet long, it weighs only 380 pounds and makes 50 miles on a gallon of gasoline. The gas tank is located on the under side of the wing, just above the pilot's cockpit, and holds only two gallons. On Dormoy's first trial flight in the Bathtub, he reached an altitude of 2500 feet.



A plane without a fuselage. The "Flying Bathtub" at McCook Field, Dayton, Ohio

Famous Old Whaler Wrecked by a Hurricane

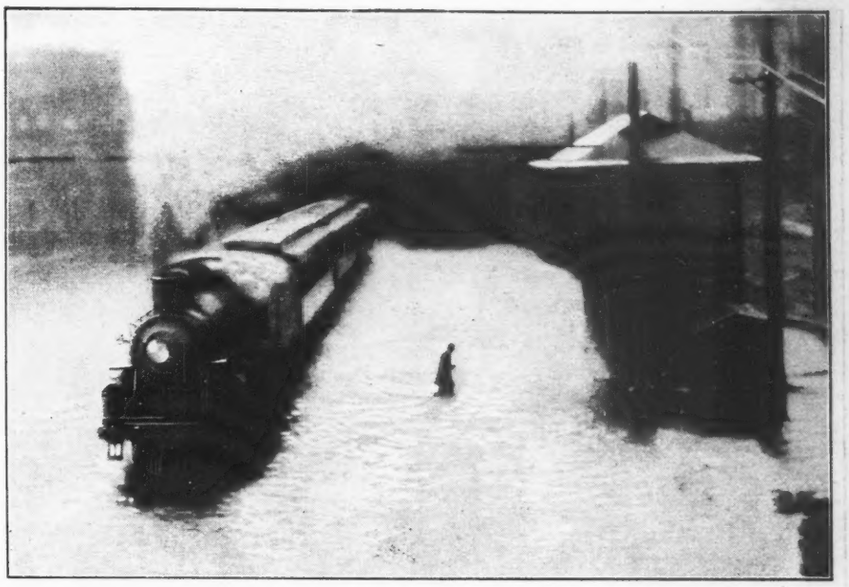
MANY a cruise full of adventure was made in the old whaling bark, the *Wanderer*. Every fisherman up and down the New England coast knew her, and told stories of the good old days, when she was in her glory.

Now she is on the rocks of Cuttyhunk Island, Mass., swept there by a terrific storm. Piece by piece, she is going to her burial in the Atlantic.

The famous old whaler, last of her line, had barely left New Bedford, Mass., on

The whaler *Wanderer* on the rocks

what was expected to be her final voyage—a cruise to the south Atlantic—when a hurricane hit her. During the gale the bark dragged her anchor and drifted toward Cuttyhunk. Seeing that she was headed for the shoal, the crew abandoned her to her fate, and every wave carries her nearer to her doom.

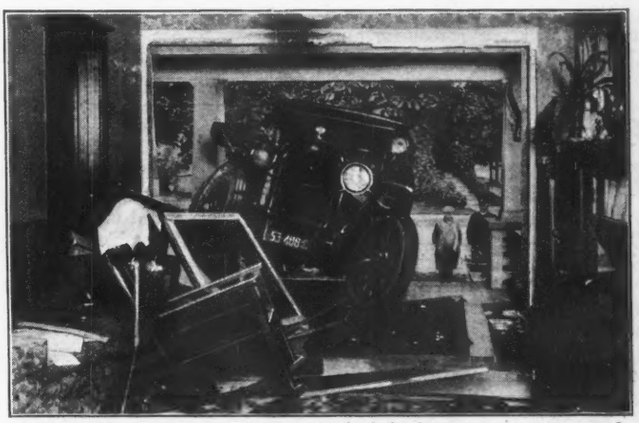


Trains "Swim" through a Flood in Boston

BEING pulled by an engine through a flood was the unusual experience of passengers on trains that entered Boston recently following a severe storm. The switchman had to don his hip boots in order to wade out from the traffic tower across the submerged tracks to give instructions to the engineers. While the railway service was crippled temporarily, the flood soon subsided.

Auto Makes a Call

THIS is not a photograph of a trick scene in a motion-picture film, but the record of an actual impromptu call made at the home of T. J. Quirk in Portland, Ore., by a woman driver who lost control of her car. Instead of stopping at the curb as she had intended, she stepped on the gas, and the car climbed the front porch steps and crashed into the living-room.



An unwelcome guest. This car climbed the front steps and entered

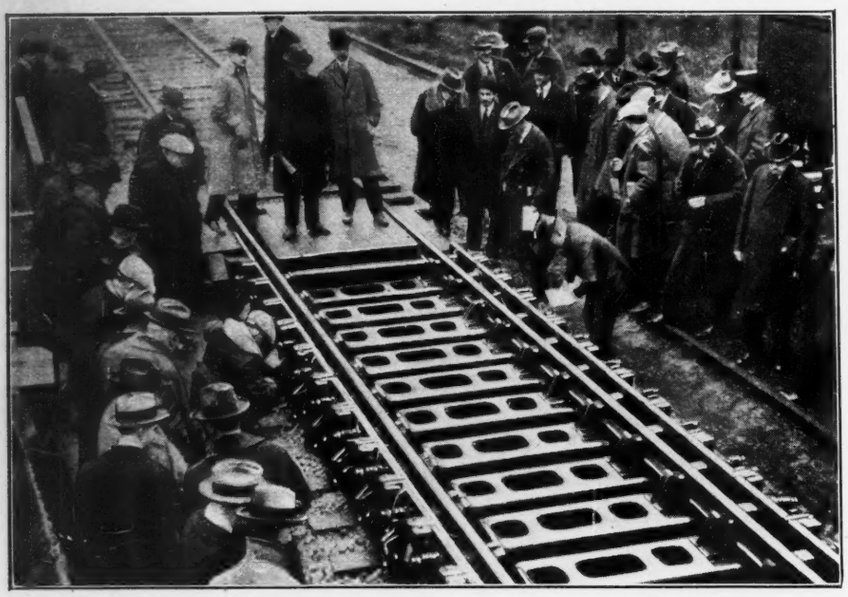
In spite of the damage to house and car, no one was injured, except for the shock to the driver and the members of Mr. Quirk's household.

This Aviator Picked a Soft Spot, but His Plane Was Wrecked

After the crash—the wrecked plane covered with hay after plowing into the stack

THOUGH the aviator who made a landing recently in a haystack near Roslyn, S. Dak., escaped without so much as a bruise, his airplane was wrecked as a result of the collision. The hay was very loosely packed. For this reason one might think that the plane would have been able to plow through or ride over it without damage; but planes are designed to withstand only certain definite stresses, and are of necessity easily demolished in a collision.

The accident was caused by striking the topmost branches of a cottonwood tree as the plane—a homemade machine, designed and built by the flier—approached the ground after a successful flight. The hay that was knocked from the stack fell back upon the wreckage and almost buried it, as shown in the accompanying photograph.



Strain on the Rails Charted and Measured

A NEW machine, known as the "otheograph," has been installed on a section of railway track at Erie, Pa., to give a graphic record of the downward pressure and lateral movement of locomotives and railway cars passing over a certain section of track. The device makes a chart of these forces for any or all of the wheels of the vehicle used in the test.

The otheograph consists of 25 special ties covering about 50 feet of track. These are laid in place of the usual wooden ties so that the roadbed remains similar to its condition before the adding of the machine. The forces exerted on each tie as a locomotive or train passes are measured by sets of heavy springs. These are connected with a recording arm that draws a chart for each wheel on a paper cylinder.

Power Plant Roof Holds Two Tall Chimneys

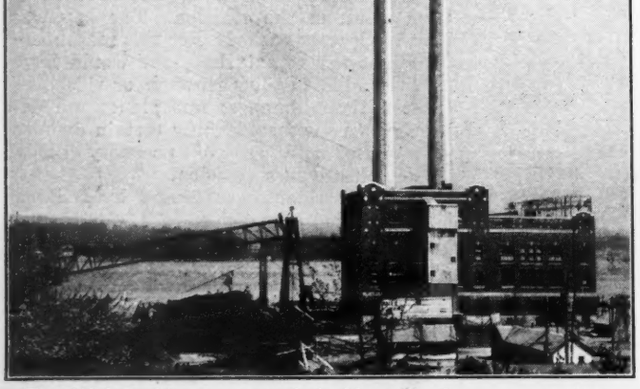
DESIRE to economize space and building cost recently induced the owners of a power plant in Montville, Conn., to superimpose two 160-foot chimneys, each weighing about 750,000 pounds, on the structural skeleton of the power house, instead of following the usual method of erecting the chimneys directly upon a ground foundation at some distance from the building containing the heating plant.

The ground surrounding the power house was needed for the storage of coal and no part of it could be spared for the chimneys. Moreover, it was desired to carry the tops of the chimneys to a height of 250 feet above the ground, and by placing the stacks on top of the building a considerable saving in the cost of construction became possible.

Each of the chimneys has an outside diameter of 15 feet 6 inches at the bottom and of 11 feet at the top. The minimum inside diameter is 10 feet. In the lower 50 feet a four-inch fire-brick lining is used. Each chimney rests on a concrete mat 18 inches thick placed on an octagonal frame of steel girders. These girders are supported by the steel columns of the building structure.

The lower sections of the chimneys are anchored by vertical steel rods, 1¼ inch in diameter, spaced about 18 inches from center to center and passing through the concrete base to the steel framework of the building.

The roof of the power house does not come in direct contact with the chimneys. The lower part of each chimney passes through an opening in the roof, which leaves a space of about eight inches between the chimney and the roof curb. A concrete apron overlapping the curb was cast in a recess around the chimney. The space between the roof slab and the chimney is utilized for ventilation.



Two 160-foot chimneys on roof of a Montville, Conn., power plant

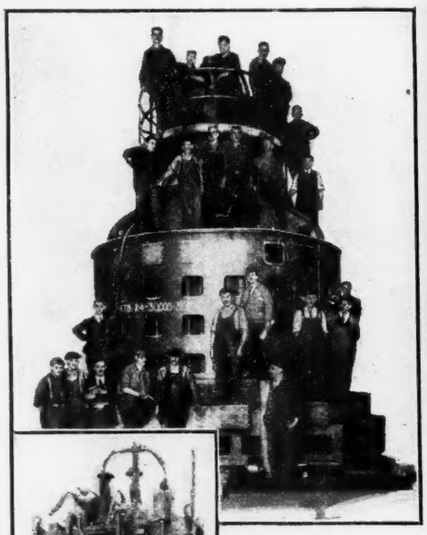
CERTAIN tropical hard woods are so dense that they will not float in water. They are transported on rafts of bamboo.

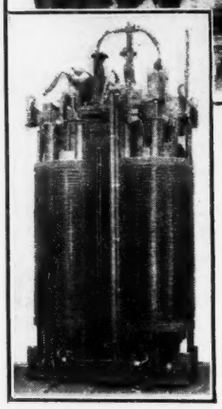
Huge Generators Built for Nippon Power Plant

THE two largest vertical water-wheel driven generators ever built for foreign service recently were completed by the General Electric Co. for use by the Nippon Electric Co. of Japan.

Each generator weighs approximately 500,000 pounds. Both will be placed in a new power plant known as the "Kanidera Station," located about 180 miles inland from Osaka, a seaport and the industrial center of Japan.

Power will be utilized from the Miya River at a head of 445 feet, and 1500 feet of water every second will be necessary to supply the water wheels driving the generators. The current will be transformed from 11,000 to 154,000 volts by two banks of transformers.





One of the two immense water-wheel generators built in the United States for the Nippon Electric Company of Japan. Note its huge size compared with that of the men. At the left are the transformers designed to step up the plant's voltage

Chicago Factory Builds Its Own Water System

UNABLE to obtain water from the city mains in Chicago, Ill., a large manufacturing plant near that city recently built a unique but effective water system of its own. It consists of an underground pumping station 357 feet below the surface, connected by pipe lines with 10 wells, from 1200 to 1500 feet deep. The pipe lines run through properly reinforced tunnels.

Sinking the shaft through water-bearing seams, driving the tunnels through falling shale, locating the wells and connecting them with the tunnel system were some of the difficulties encountered by the builders. All but two wells were found within the limits of the headings, eight feet wide, and these two had drifted in drilling.

House Cut in Half to Make Two Dwellings

A "DIVIDED household" accurately describes a family in Atlanta, Ga., which recently had its large house split into two parts. While the division was taking place, domestic duties were carried on with difficulty. The family ate breakfast in the north half, but before noon the gas and water in that side were out of commission, so they had to dine in the south side.

The house was a large building with stucco finish, which caused difficulty in breaking it neatly. By skilful carpentry the structure was sawed clear through the middle, from roof to basement.

The left half will remain on its present foundations, while the right half is moved several hundred feet. The raw faces of the two sections will be remodeled and rebuilt in symmetry with the whole, to produce two complete and attractive homes.

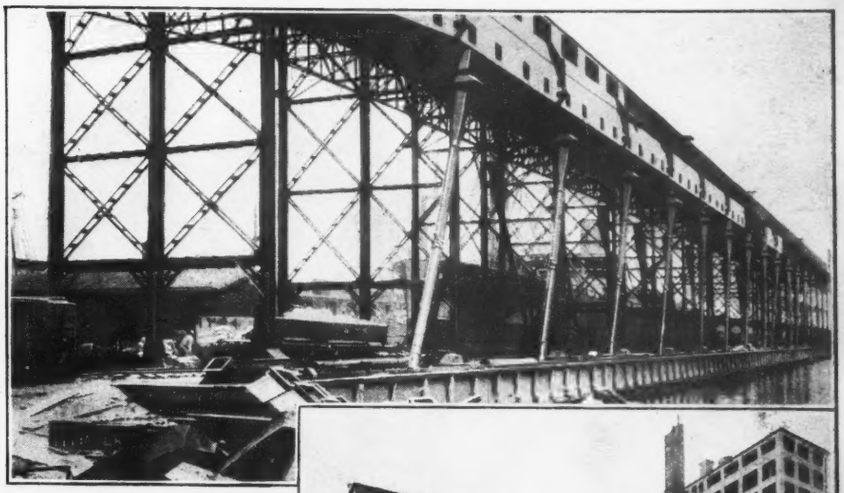
Two sections of the divided house

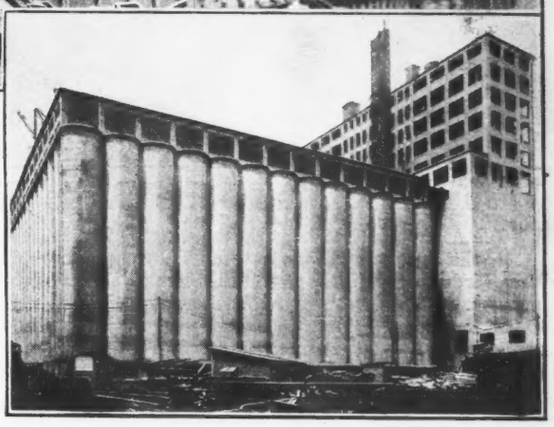
Magnet Machine Picks out Clinkers; Saves Coal

ELECTROMAGNETS of great power are used in new types of fuel-saving machinery to pick the clinkers out of the unburned coal. Successful tests of these machines recently were completed under the supervision of the U. S. Bureau of Mines.

The principle underlying the new type of clinker separator depends on two simple facts: first, that clinkers and coal do not fuse and, second, that practically all clinkers contain a little iron and are therefore weakly magnetic. The new machines pass crushed furnace wastes under electromagnetic drums, which lift out the magnetic clinker particles and permit the non-magnetic coal to pass on, to be returned to the bins.

Savings well worth figuring may be effected by salvaging unburned coal from furnace wastes, government experts say. One well known combustion engineer estimates that the average amount of combustible in the refuse from a large stoker-fired boiler plant is about 15 or 20 per cent.





The top illustration shows pier from which four ships may be loaded at once, and the lower shows the new grain elevator

World's Speediest Grain Elevator

THE city of Baltimore, Md., is about to set in operation what is claimed to be the fastest grain elevator in the world, incorporating many new and interesting features. Only eight minutes will be required to unload a car of grain, and only six minutes more to weigh the grain and transfer it to storage bins or to waiting ships into which it can be reloaded at the rate of 150,000 bushels an hour.

Through the use of electrical signals and controls, only 77 men will be required to run the plant. One man may control the loading of eight vessels simultaneously, the grain being carried out on belt conveyors.

The new elevator cost $5,500,000. Its storage capacity is 4,000,000 bushels and there is provision for erection of storage tanks capable of handling 6,000,000 bushels more. The accompanying photographs show the concrete storage bins or tanks with a capacity of 4,000,000 bushels, and one of the new piers from which four ships can be loaded at one time. The belt conveyors run overhead in the inclosed galleries, carrying the grain directly from the storage tanks to the end of the pier, where it is loaded into the ships.

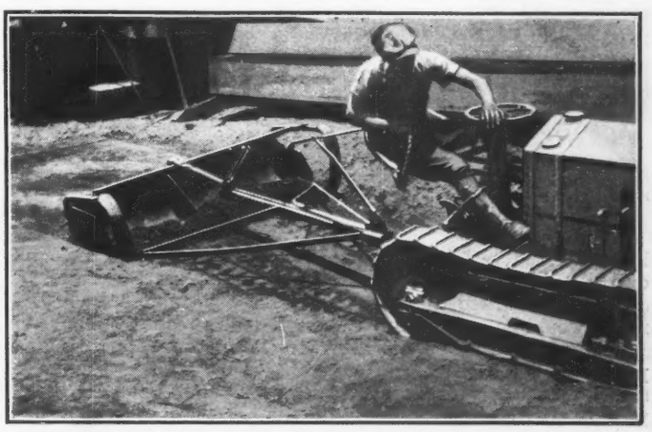
New Tractor Excavator Sets Speed Record

WHEN a new excavating device recently invented by a Californian was given its first practical test, it proved its merit by breaking all speed records for rapid removal of earth. The task consisted in excavating a sump hole or reservoir, 80 feet long, 40 feet wide, and approximately seven feet deep, near an oil well at Ventura, Calif.

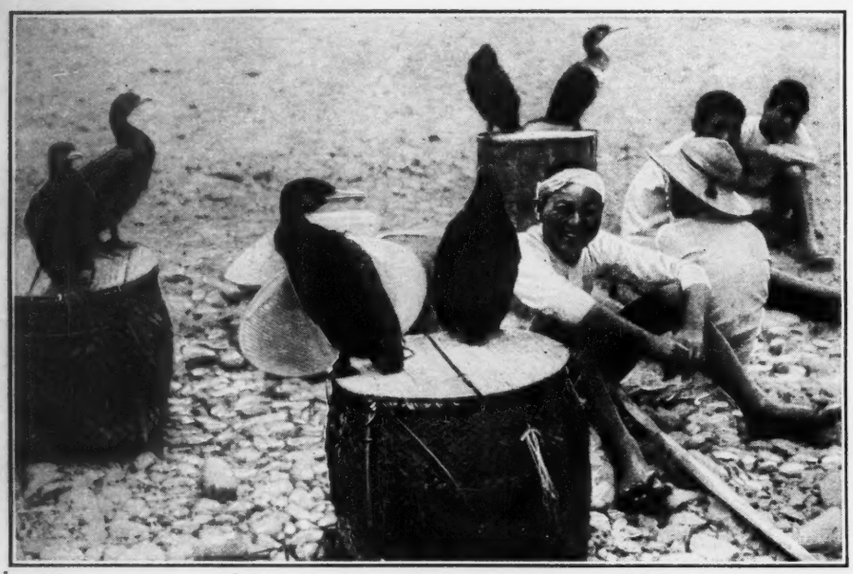
One man and a tractor, together with the patented excavating scoop completed the job in 40 hours, a task which would have required 10 days' work for 10 men and 16 horses.

The principal feature of the device is the manner in which it is hitched to the tractor. By a single controlling handle, the tractor operator, without leaving his seat, can load the scoop with earth, transport it to any desired spot without spilling its contents, and dump the dirt there. This excavator can dig square corners impossible to excavate with horse-drawn graders.

During the 40 hours which the excavating required, the machine made 1800 trips and removed 900 cubic yards of earth.



The new excavating scoop, showing attachment to tractor, and controls



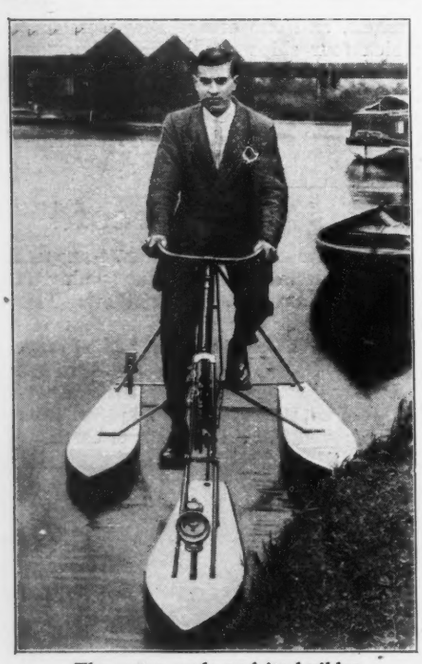
Japanese Make the Birds Fish for Them

WE ALL make beasts work for us, but the Japanese go one better. They force birds to help swell the family bank account. They have taught cormorants to fish for them. Rings around the necks of the birds prevent them from swallowing the fish that they catch in the sea glades and the Tama River near Tokio.

The fishermen, sitting at ease in their boats, control the movements of the birds by leashes, which they hold in their hands.

Bicycle-Boat Skims Waves at High Speed

COMBINING the principles of speed boat and bicycle, an Englishman, George R. Stevenson, has invented a foot-propelled water bicycle that is said to be very successful and to attain high speed. The device consists of the usual bicycle frame with three pontoons, one on the end of the front fork, and one at each side of where the rear wheel ordinarily would be.



The water-cycle and its builder

Motive power is supplied from the pedals through gears and a propeller shaft, the pedals driving a small propeller located at the rear end of the shaft. The shaft runs through and is supported by a projection of the frame in the rear. Each of the rear floats that support most of the weight is five feet long, one-foot beam, and eight inches draft, while the front member is four feet six inches long with the same beam and draft.

The front float is pivoted so that it will ride over waves instead of bucking through them, thus tending to keep the bicycle-boat on an even keel in rough water. The machine is said to have towed a 16-foot dinghy carrying six persons.

World's Largest Crystal Spheres on Exhibition

THE two largest flawless crystal spheres in the world recently were exhibited at a large department store in New York City. One of them measures nine inches in diameter and the other just fifteen-sixteenths of an inch less. Their weights are 500 Troy ounces 13 pennyweights, and 493 Troy ounces 17 pennyweights, respectively. The value of the pair is placed at $50,000.

The spheres were brought to New York from China, where they were cut from a perfect Burma crystal with a small metal hatchet. The work required infinite patience.

The two largest crystal spheres

This fascinating crystal substance always has held a charm for people of all ages. In the Far East and in Europe in ancient times it was supposed to be ice in permanent form.

In Japan small crystals were said to be the breath of the Great White Dragon, while the larger ones were supposed to come from the Violet Dragon. The crystal is emblematical of purity, infinity of space, patience, and perseverance.

A Practice Putting Green on the Carpet

AS A means of keeping up one's golf putting ability during the winter months and to afford a practice device that may be used anywhere, a putting board recently was devised.

This consists of a cast aluminum plate that has a regulation size putting hole in its center. It rests on the floor at an angle from 15 to 25 degrees. At the top is a trough for catching balls that miss their mark. When the ball is "sunk" in the hole, another trough turns it out.

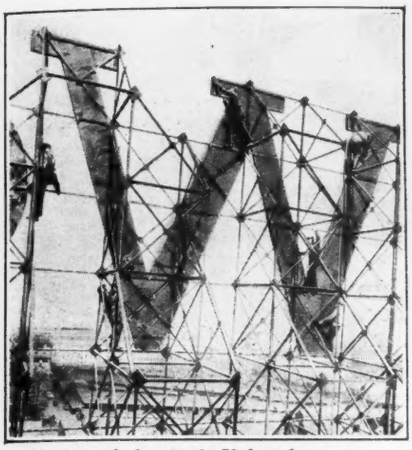
The "green" may be of any floor covering, although corrugated rubber matting is said to be preferable to insure accuracy.

An indoor putting match, showing the artificial inclined "green"

Huge Electric Sign Has Letters 50 Feet Tall

FOUR thousand lamps are required to illuminate a gigantic electric sign recently erected in Philadelphia, Pa.

The sign is 250 feet long, nearly the length of a city block, and weighs more than 50 tons. The letters are 50 feet high. The power required to illuminate the sign, it is said, would supply light for a town of 6000 people.



One of the sign's 50-foot letters

© Keystone

Children "Go Motoring" in Bicycle Trailer

A HANDLE-BAR seat may be all right, but two small children in Winthrop, Mass., have something better —a bicycle trailer, which they consider the latest in comfort and luxury. Their friend, Harry V. Grandin, hitched a pair of wheels to the back of his bicycle, then asked them to take a ride.

The construction of the "turnout" is so simple that any father could make one for his children. All he needs is willingness to provide the man-power to run it.

Cold Baths in Lake Depths Fatal to Fishes

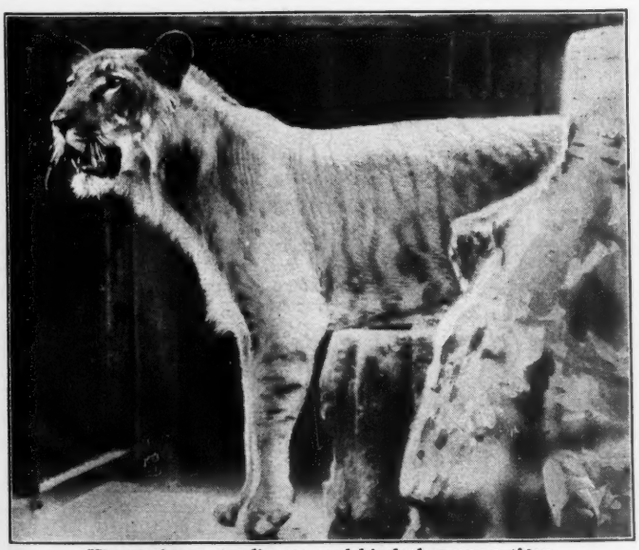
FISHES may die from a cold bath, according to a report made by Prof. Frank Smith of the Zoology Department of the University of Illinois to the U. S. Bureau of Fisheries. This conclusion was based on a series of experiments with fishes in water of varying temperatures.

Professor Smith conducted his studies at Douglas Lake in the northern part of Michigan. There are a number of deep places in this lake where the water does not circulate and therefore becomes much colder than the layers of water immediately above, so that the thermometer will show a drop of several degrees in two or three feet.

Fishes of several species, lowered to varying depths in wire cages, remained alive if kept above the cold depths, but died if they were left in the region of low temperature. Chemical analyses of the water showed that there was much less oxygen dissolved in the cold water than in the warmer layers, and also that other chemical conditions at the lower level were unfavorable to life.

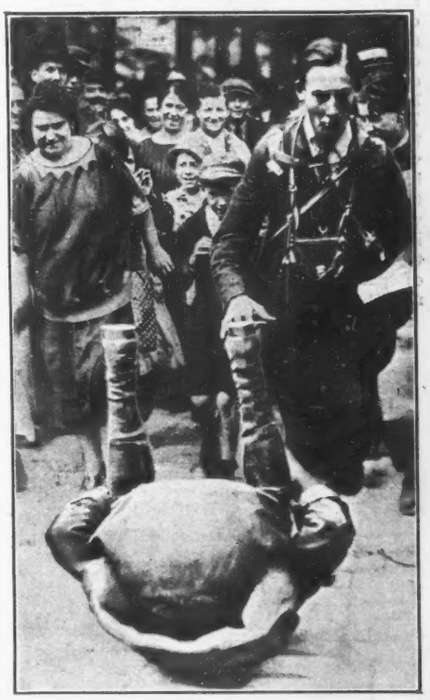
The "Tigon"—Latest Oddity in the Zoo

MEET the "tigon," a new member of the animal kingdom. With a lioness for a mother and a tiger for a father, this new arrival at the London Zoo shows resemblance to both. It takes after its mother for the greater part, but tiger stripes can be seen on his shoulders and legs, though not strongly marked.



His mother was a lioness and his father was a tiger

When it first arrived in London from India, the animal was called a "liger," in the belief that its mother was a tigress and its father a lion. It was bred and presented to the zoo by the Maharajah of Nawanagar, better known as Ranjitsinghi, the cricket player. The Maharajah is said to possess more millions than he ever can count, and he delights in discovering curiosities and making them known to the world.



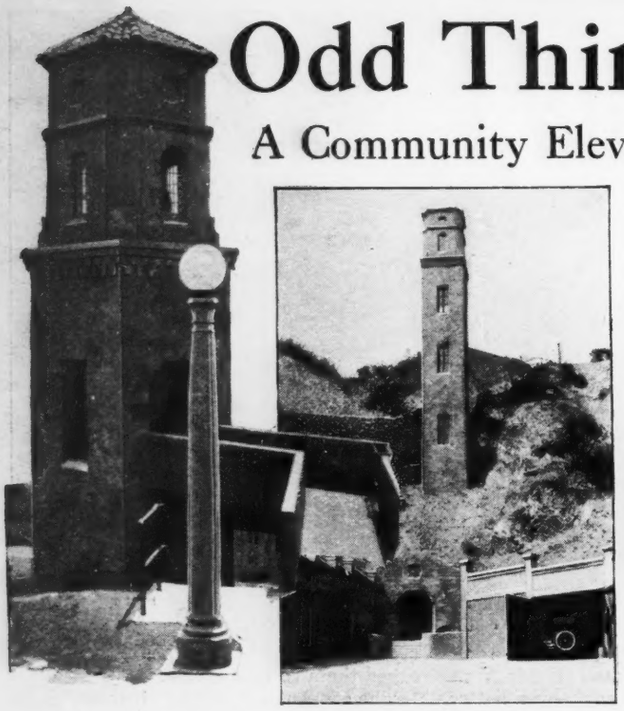
Somersaults 900 Miles

MANY a queer thing has been done to win a wager, but few as odd as that chosen to be performed by a Dutchman named Takkenberg, who is traveling from Amsterdam, Holland, to Marseilles, France, a distance of 900 miles, by somersaults.

Takkenberg has completed a large part of his journey, which began on November 12, 1923, and must be completed by February 12, 1925. He covers from three to four miles a day. The Dutchman calculates about 2,000,000 somersaults will cover the journey.

Odd Things People Are

A Community Elevator—Italy's Super-Skyscraper—



Elevator Serves Hilltop Community

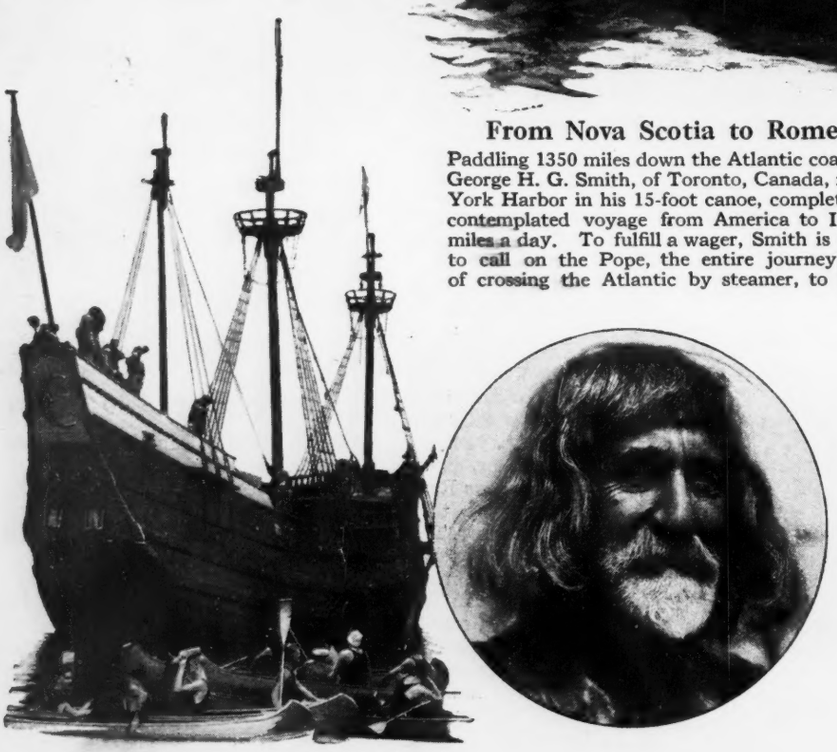
With an opportunity to divide a beautiful hilltop into residence lots, providing he could make them accessible, an enterprising property owner of Hollywood, Calif., constructed the outdoor community elevator pictured above. A tunnel into the hill gives access to the base of the shaft, where an automatic electric elevator carries passengers to the hilltop—a distance of about 75 feet. Near the top of the tower a door leads to a walk connecting with the hilltop street, as shown at the left. Above the doorway is an observation room in the tower. Near the tunnel entrance is a group of garages, seen at the right, one for each home

An Auto Barber Chair

Guaranteed to keep small children from crying while having their hair cut, this automobile chair recently was installed in a barber shop in Mt. Carmel, Pa. For the thrill of being allowed to steer the car and toot the horn, who wouldn't submit to the barber's clippers? The idea originated with Harry Phillips. The little automobile can be swung in a circle and raised or lowered

From Nova Scotia to Rome in a Canoe

Paddling 1350 miles down the Atlantic coast from Nova Scotia, George H. G. Smith, of Toronto, Canada, recently entered New York Harbor in his 15-foot canoe, completing the first leg of a contemplated voyage from America to Italy, traveling at 30 miles a day. To fulfill a wager, Smith is on his way to Rome to call on the Pope, the entire journey, with the exception of crossing the Atlantic by steamer, to be made in a canoe



A Replica of Hudson's Ship

Celebrating the 315th anniversary of Henry Hudson's landing in New York, an exact replica of Hudson's boat, the *Half Moon*, with the explorer and his crew of 20 on board, sailed up the Hudson River recently and made a landing in the presence of thousands of cheering spectators. In the larger photograph Hudson and his men are seen just before lowering the gangplank. Reginald P. Bolton, shown in the round photograph, took the part of the hardy English explorer in the pageant. When Hudson went up the great river that now bears his name, in the *Half Moon*, he was looking for a northwest passage from Europe to China, but turned back on reaching the point where Albany now is

Doing and Making

The Largest Boot—Walking on Wheels

He Walks on Wheels

Walking on wheels saves energy and gives all the pleasure of skating, according to a Swiss engineer who fits wheels to his shoes when going to work, as pictured above. The skates are fastened to the shoes with clamps and braced by rigid anklets

A Six-Foot Boot

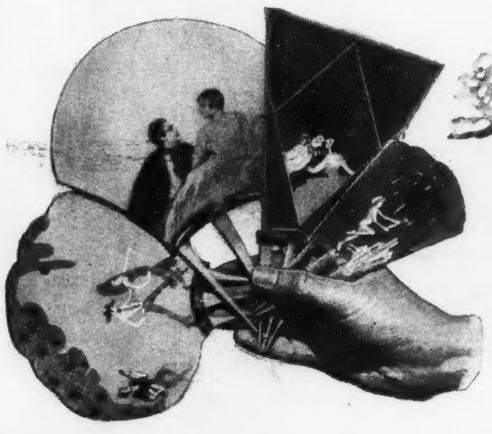
Here, at last, is an approach to one of the seven-league boots of fairy lore—a giant boot six feet tall, recently displayed at a shoe and leather exhibition. The old woman and her family really could have got into this leather house. Three babies could go to sleep in its toe alone. Beside this huge specimen are four of the smallest shoes ever made, with a pair of rubbers to match. Hours of painstaking workmanship were required to produce the little shoes, which are exact replicas of those of ordinary size

Italian Skyscraper to Overtop Woolworth Building

America will lose one point of distinction when the world's tallest skyscraper is completed in Rome, Italy. This building will have 88 stories and will be 1100 feet high—308 feet higher than the 51-story Woolworth Building in New York City. It will be used as a great community center. It will have 4500 rooms, 100 halls, a huge theater, a concert hall, gymnasium, swimming-pool, and libraries

Oregon Man Strikes Gold in His Back Yard

This photograph might be used to illustrate the old story that teaches that the pot of gold lies near at home. The hero, who lives at Grant's Pass, Ore., went out in his back yard one morning recently and discovered gold. In the picture he is seen examining the riffles in which the tiny specks of gold accumulate. If this story has any moral, it is not that we should all dig up our back yards, but rather, that it might pay us to move our belongings to Grant's Pass



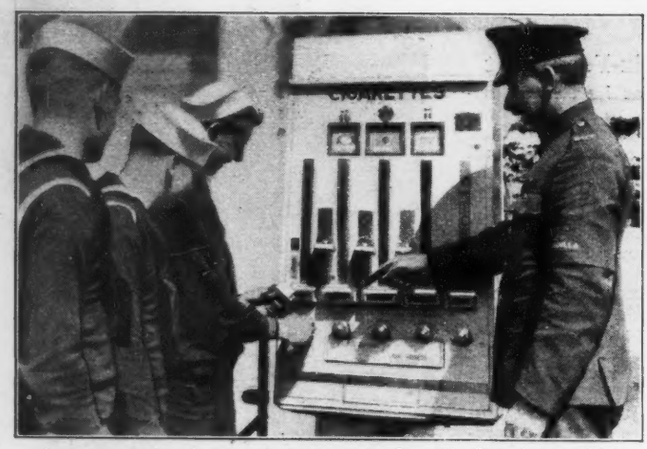
Invents "Love Comb"

The latest fashion in hair adornment is the "love comb," carved elaborately by hand in wood and painted to represent love scenes from famous plays. The inventor is Miss Lettice Apperley, 18 years old

Cigarettes Now Are Sold in Slot Machines

SLOT machines for matches and candy and other items are a familiar sight in America, but slot machines for small boxes of cigarettes proved quite a curiosity to a party of United States sailors in London not long ago.

Several different varieties are offered so that all tastes may be met.



American sailors buying their cigarettes from English slot machine

A coin in the slot and a turn of the knob quickly furnish whatever is wanted. Matches also are carried in the machines.

These machines are particularly convenient to the smoker after the regular shops are closed.

THIN sheet metal, used in making toy houses, now is being employed in Budapest, Hungary, in building real dwellings. Four-room bungalows covered with metal veneer can be built in 24 hours, it is said.

One Golf Club Replaces Usual Heavy Bagful

TO ELIMINATE the burden of carrying a heavy and unwieldy bagful of golf clubs, F. E. Ganders, of Walla Walla, Wash., has invented a universal golf club with which he says the whole game may be played as expertly as when the usual set of clubs is carried.

The new device resembles a midiron, but the blade may be swung into any position, instantly converting it into a driver, mashie, putter, etc. This is made possible by a V-toothed sleeve on which the blade is mounted. This operates on two gear-shaped members that are inside the sleeve. To set the blade at any one of its various positions it is necessary merely to pull back the sleeve so that the gears may be set as desired. Releasing the sleeve locks the blade automatically.

Driver, mashie, niblick and putter clubhead

A Museum of Buttons

IN PRAGUE, capital of Czecho-Slovakia, is a button museum in which, it is said, every type of button ever manufactured is displayed. The museum is the only one of its kind in the world. Some of the buttons date back 3000 years B.C.

New Burglar Alarm Is of Simple Construction

WHEN a door or window, equipped with one of these new removable burglar-alarms, is moved by the stealthy burglar, a bell rings so loudly that he probably will be frightened away. The construction of the device is unusually simple, having no locks, bolts, nor wiring. It is eight inches long and the complete apparatus weighs one pound.

Bell burglar alarm

The burglar stop consists of a jack. When the upper arm is bent inward by opening the door, the button of a bell attached to the lower arm is pressed. The bell rings as long as the door is open.

Disappearing Bag Handle Lessens Chance of Theft

A HANDLE on a traveling bag is a standing invitation to thieves, says the inventor of a new loop bag handle that disappears at the owner's will.

Any one who has tried to carry a bulky traveling bag the handle of which has been broken off, appreciates the difficulty of the task. It slips and it slides and sometimes it falls. At least if there were two bags side by side, one with a handle and one without, there is little doubt which one a thief would choose to carry away.

The loop handle is made of steel and folds inside the bag when not in use. The handles are made to fit any standard frame and can be put on in place of the regular loops by an adjustment that takes but a few minutes.

False Teeth Made of Steel

FROM the steel that once was used in making big guns, the Krupp works of Germany now are manufacturing single and double rows of enameled steel false teeth.

At present eight dentists are employed in this new department, and it is reported that the steel teeth are becoming increasingly popular because of their durable construction.

Rainproof Motorcycle Shed Is Collapsible

A SPECIAL garage for the motorcycle is one of the latest novelties to come from Germany, where the motorcycle has replaced the automobile in many cases because of its economy.

The miniature garage is made of galvanized iron and is weather-, fire-, and burglar-proof. Protection from thieves is assured by special locks.

Collapsible motorcycle garage is weather-, fire-, and burglar-proof

Bachelor's Collar-Ironer Is Useful in Emergency

HE WENT to the dresser, but no clean collars were there. To meet this predicament, an all too common one, a device has been invented that will enable a man hurriedly to wash out a collar and iron it in a minute, with results like those obtained in the laundry.

The washed collar is placed around an electrically heated cylindrical form and another heated form is placed over it.

Collars can be more easily shaped by using this device, it is claimed, and will last longer than if ironed with a flatiron.

New Dry Polish Replates Silver or Nickel

RUBBING with a dry polish that comes in cake form, is the latest method of replating worn silver or nickel ware. The method does not involve the use of mercury or acids, usually employed, but is based on the principle of frictional electricity.

The action of the dry powder is like that in an electric battery. The silver or nickel is in fine form as in an electric battery solution, and is deposited on the object being polished, when electricity is produced by rubbing.

Baby-Carriage Speeded Up by Self-Starter

PUSHING a baby-carriage is usually a joy, but sometimes, particularly if one lives in a hilly town, it is real labor.

An English minister, the Rev. Percival Mackenzie, saw no good reason for using man or woman power for what could be accomplished by machinery. So he went to a second-hand motor-accessory shop and procured an automobile self-starter, which he attached to his baby's carriage. It is so geared that, while there is no danger of excessive speed on the level, the perambulator will climb a hill with ease.

Any motor-car, whether for grandfather or baby, must have a license. Observe the white label containing the number of this vehicle at the upper center of the carriage body.

© K. & H.

The self-starter is hung on a frame under the baby-carriage

Miniature Vacuum Cleaner a Boon to Travelers

The cleaner in use

AT THE end of a long motor trip, when his clothing is covered with dust, the motorist would best appreciate the value of a newly manufactured vacuum cleaner installed in the automobile and run by the car's motor.

The cleaner is good, also, for cleaning carpets and the upholstery of an inclosed car. Its equipment includes 10 feet of rubber tubing, which is ample to reach all corners of the car. The dust is collected in the handle of the nozzle, and may be emptied at the end of each cleaning operation.

LESS than 50 years after Edison produced the first practical model, more than 350,000,000 incandescent electric lamps now are in use in the United States. The annual demand is more than 200,000,000.

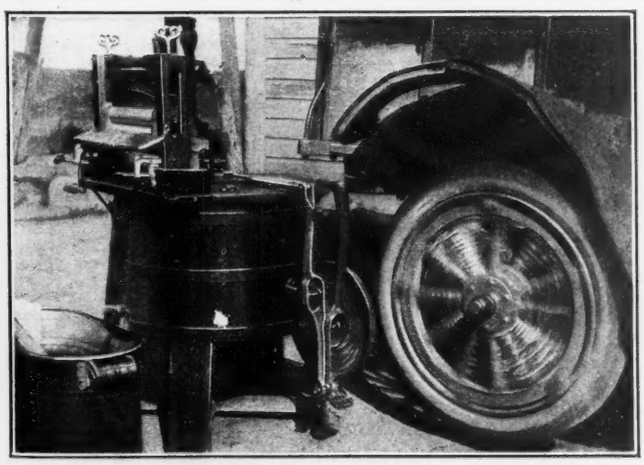
Electric Lawn-Trimmer Saves Back-Bending

ONE of the latest garden conveniences is an electric lawn-trimmer. The machine was invented by T. W. Martin, of North Hibbing, Minn., and consists of a device similar to a hedge-trimmer, mounted on two wheels and run by an electric motor.

New lawn-trimmer equipped with motor

Power for the motor is supplied from the regular house current by means of a cord, sufficiently long to enable the machine to be used at any corner of the lawn. Increased speed and greater convenience are claimed for the device.

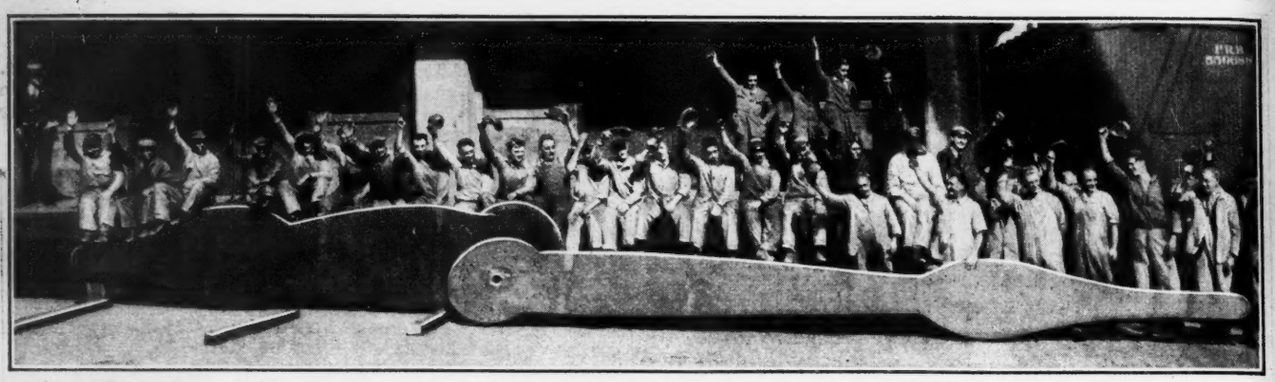
Automobile Engine Runs a Washing Machine



How the automobile engine was hitched to the washing machine

TO SAVE his wife the strenuous exertion of a washday, an energetic New Jersey husband backed his car up to the washing machine, jacked up one rear wheel until it came in contact with the drive wheel of the washer, and started the engine.

The result was a motor-driven washing machine in which a friction drive was substituted for gears or belts.



Minute Hand of the World's Largest Clock Weighs a Ton

A SMALL army of workmen was required to hoist into position the giant hands of the largest clock in the world, installed on top of a factory in Jersey City, N. J.

The minute hand alone weighs a ton, and is more than 27 feet long.

In place of numerals on the clock face, which is 50 feet in diameter, there are great oblong blocks, black in the daytime, which flash with electric lights at night.

By means of the lights the time can be ascertained by a person across the Hudson River from the factory—more than a mile away.

Two freight cars were required to transport this unique timepiece from the factory in Connecticut, where it was made. The photograph, showing workmen sitting on the minute and hour hands, gives an idea of the astonishing size of this New Jersey landmark.

Alex, at 70, Tosses a Sapling

IN SCOTLAND, athletes contest at sports worthy of the great clansmen renowned in legend, history, and song.

Alexander MacIntosh, an athlete well in his seventies, is shown tossing the caber, a sort of young telephone pole. Those who think this feat simple should get a good-sized sapling and try a few tosses to see how far they can throw it.

Alexander MacIntosh, 70-year-old Scotch athlete, tossing the caber

Mountain of Shells

IF YOU ever have wondered what becomes of all the oyster shells, this picture will furnish part of the answer. It shows a mountain of shells at one of the world's greatest oyster ports in Baltimore, Md. Most of the shells are finely ground and converted into chicken feed.

Climbing a mountain of oyster shells

Would Build Steel Homes in a Few Hours

A REMARKABLE solution to Great Britain's housing problem recently was offered by Lord Weir, prominent Glasgow iron and steel manufacturer, in the form of mass production of standardized steel houses which, he declares, can be erected in a few hours.

To demonstrate the practicability of his proposal, Lord Weir has erected near his factories in Glasgow a workingman's three-room house of steel which, he says, can be built under the mass-production plan, for $1500, exclusive of the cost of the land and sewerage. He adds that after the concrete foundations are completed, the house can be erected in a day.

Standardization, according to the plan, will meet the shortage of skilled labor. Even the piping will be made in standard lengths and screwed together instead of being soldered.

The framework of the experimental house is of wood, to which are bolted steel plates. All the factory-produced pieces are numbered for ease in assembly.

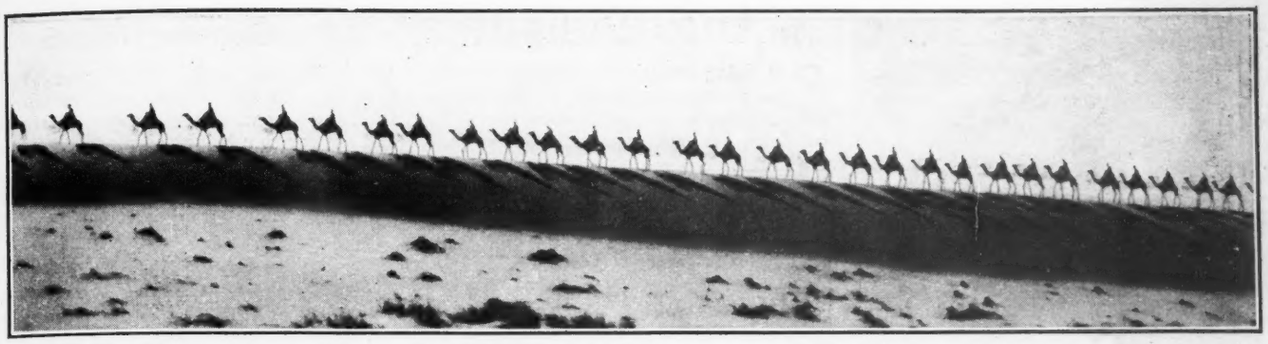
Between exterior and interior sheets of steel is a felt lining for insulation purposes. The outside steel shell is painted, while the interior steel walls are lined with beaver board. The roofing is fireproof.

Primitive Japanese Water-Wheel

ALL day long, with the hot sun beating down upon his head, the Japanese boy pictured below turns the paddles of a primitive water wheel with his feet, diverting water from the main irrigation canals into the ricefields. The wheel is placed at right angles to the main canal, and the turning of the paddles laps some of the water into the side ditch.

While Japan is one of the most modern of countries in some respects, in others she is most primitive. Japanese farmers still use the implements most favored by their great-grandfathers. It hardly seems possible that in this age of electricity, manpower should be employed in such an arduous task as turning this water-wheel.

Japanese boy turning a treadwheel



The Egyptian Camel Corps—a Terror to Outlaws of the Desert

AS THE first rays of the rising sun come to change the chill of a desert night into the heat of a burning day, this long line of camels is seen on the shifting dunes of the Sahara. It is the Egyptian Camel Corps, the terror, throughout the country, of all bands of outlaws.

Vast as the desert is, one might suppose that here it would be easy for a caravan robber to flee to where he could not be followed. But the Camel Corps of native Egyptians, officered by British, know all of the secret hiding-places in the great wilderness of sand. As in the case of the Canadian Northwest Mounted and our own State Constabulary, it sometimes takes weeks of searching, but few are the criminals who ultimately are not dragged back to face the law.

Notice the long shadows cast on the sands by camels and riders.

Three Hens Hatch Eagle's Egg

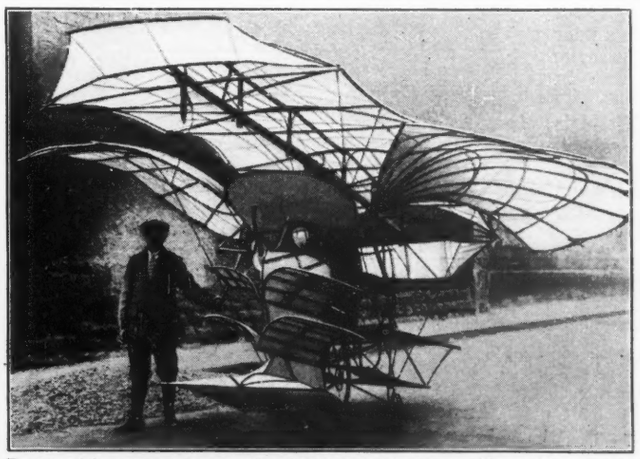
THE egg of a golden eagle, taken near San Diego, Calif., by Guy O. Glazier, of the San Diego Society of Natural History, required the services of three "biddies" to incubate it. When the patience of one hen was exhausted, Mr. Glazier put another on the job. It was 41 days before the eaglet pipped the shell.

A Face in Rock

SOMETIMES we have to tax our imaginations to see odd resemblances to animals and human beings in rocks that enthusiastic guides point out to us. But any one would see instantly the remarkable resemblance to a man's face in this natural rock formation at San Carlos Pass, Calif.

This rock is similar to the celebrated formation in the White Mountains in New Hampshire, which is known as "The Great Stone Face."

The rock face at San Carlos Pass



Designed by a Frenchman, this flying machine resembles a huge insect

Odd Manpower Airplane Flaps Its Wings

A STRANGE flying machine, powered by the arms and legs of the operator and resembling an enormous insect, has been designed by a French inventor. It weighs 100 pounds and has a wing surface of 300 square feet.

Above two wings, arranged like those of a bird, is a fore and aft fixed flying surface. Other smaller fixed surfaces curve out from the lower part of the machine. The two wings are flapped leisurely by the flyer's arms.

The machine is mounted on a bicycle, which is steadied by two small additional wheels. Pedals drive the propeller at 400 revolutions a minute.

Big Tree for Chinese Junk

THE big stick of the year shipped from the Pacific Northwest lumbering region was 137 feet long and 42 inches in diameter at the butt. On an order from a shipbuilder in Shanghai, the tree was selected after a search of three weeks. It is to be stepped as a mast in a large Chinese junk plying the Eastern seas.

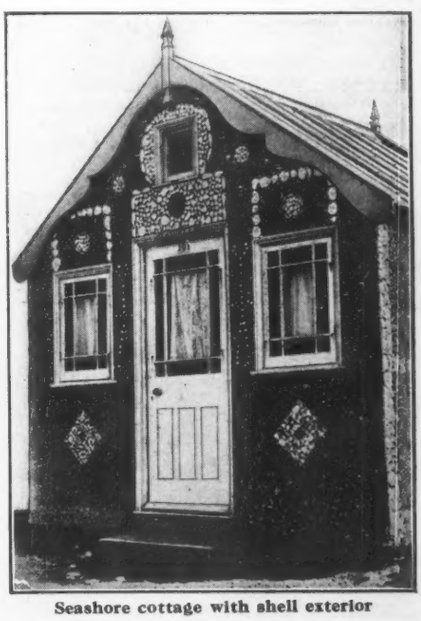
The stick weighs 19 tons. On a board basis it contains 12,618 feet—which would be sufficient wood to build a good sized house.

Cottage Is Finished in Seashells

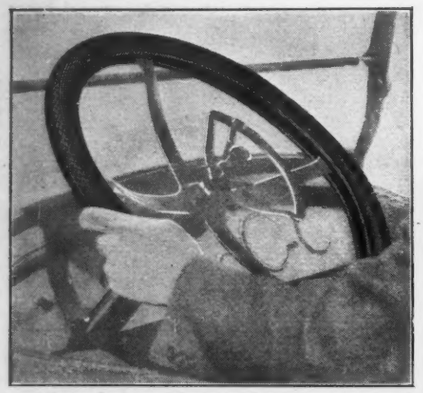
SEASHELLS usually are considered beautiful but unsubstantial articles. It remained for an Englishman to demonstrate that they can serve as a unique and durable building material when used in the proper manner.

The photograph below shows the first seashell cottage, built on the English coast near Hunstanton. The entire surface of the exterior is set solidly with all kinds of seashells of many colors, picked up from surrounding shores and set in a cement composition. The result was a brilliant and most unusual stucco in which any number of designs could be incorporated at will.

For cheapness and attractiveness the dwelling makes an ideal small cottage for the seashore, its builder declares. It has become a show place.



Seashore cottage with shell exterior



Rubber-Tire Steering Wheel Offers a Firm Grip

ONE of the useful new accessories designed for the comfort of the motorist is a rubber tire that is slipped over the steering wheel. It is said to make driving more pleasant by affording a sure grip for the hands; also, because rubber is a poor conductor of heat, it is less likely to make the driver's hands cold and numb in winter weather.

The device is a miniature tire and is easily slipped over the rim of the wheel. The elasticity of the rubber keeps it firm all around, and prevents its slipping, while the "tread" provides an effective grip for the driver's hands.

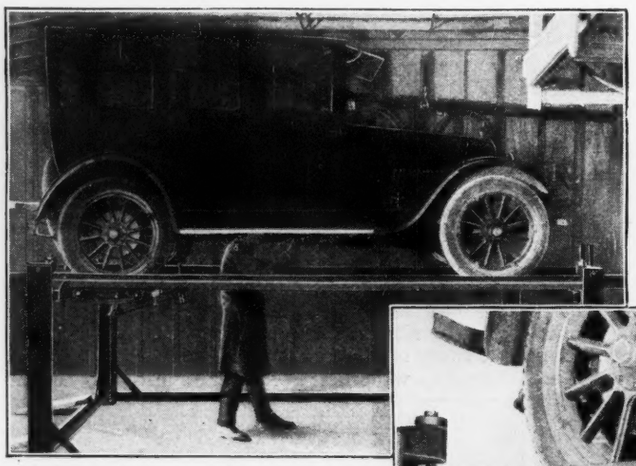
Auto Pulls Itself up for Repairs

FOR doing away with the troublesome job of crawling under the car whenever repairs, oiling, or greasing needs to be done, an ingenious self-raising platform recently has been perfected for use in garages and repair shops.

The device consists of a steel frame with raising mechanism. When in a lowered position, two rails that serve as tracks for the car are level with the floor. The car is driven on, and when it reaches the end of the track, the power from the rear wheels raises the platform and the car to a height of six feet.

This is done by a form of treadmill that is geared to a worm gear at each corner of the frame. The revolving car wheels move the treadmill, and the gears thus raise the car. It is lowered in the same way.

Economy of space and elimination of an incline are the chief advantages claimed for the device, which can be used to advantage even in a small private garage.



Platform and car elevated by power from the engine. At right: Treadmill mechanism

New Headlight Control for Night Driving

WITH a newly invented mounting for Ford headlights it is possible, simply by touching a lever under the steering wheel, to tilt the lights so that they throw their full beams directly on the pavement in front of the car, making night driving considerably easier for everybody concerned.

The device consists of a special tilting bracket on which the lamps are mounted, these brackets being connected under the hood with a small lever bolted to the steering post just under the steering wheel within easy reach of the driver's hands.

When thrown downward, headlight beams do not cast dazzling glare

Water Pump Attachment for the Small Car

How the new water circulation pump is installed in the cooling system of a Ford car

THIS water circulation pump for Ford cars is said to insure a perfect supply of water for the cooling system at all times. It is easily attached to the cooling system within a few minutes, the regular Ford hose being used. No new holes are necessary and a strong supporting bracket is designed to do away with all vibration and rattling.

By keeping the water system in perfect circulation, carbon deposits in the engine are said to be lessened. A saving of alcohol in winter also is claimed as one of the advantages of the invention.

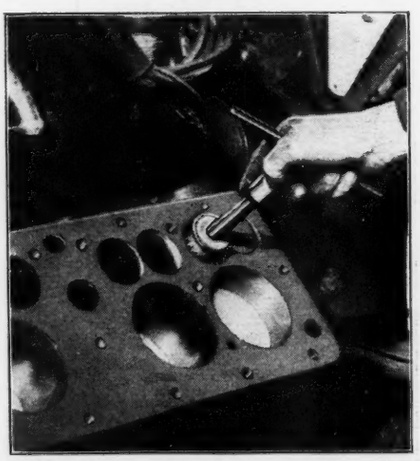
THE Editor will be glad, wherever possible, to supply the names and addresses of manufacturers of devices mentioned in this issue of POPULAR SCIENCE MONTHLY.

SYNTHETIC motor fuel made from lignite, coke, and water was tested for automobile use with successful results during the recent Liquid Fuel Congress in France.

France has large deposits of lignite and turf, from which almost unlimited quantities of this new fuel might be produced.

Handy Reaming Tool Makes Valve Seats Tight

TO ASSURE compression-tight valve seats when you do your own valve grinding, a new valve seat reamer will be found handy. The tool is said to cut rapidly, removing carbon deposits and other irregularities, at the same time facing the seat perfectly at the proper angle. It is said a few turns will quickly cut a smooth, clean face on the seat, effecting a saving of time in grinding the valve itself.



How the new valve-seat reamer is used

Motorists in 36 States Pay $50,000,000 Gas Taxes

MOTORISTS of 36 of the 48 states in the Union now are paying a tax of from one to three cents a gallon on the gasoline they use for fuel in their cars, 17 states having adopted bills authorizing a gasoline tax during recent sessions.

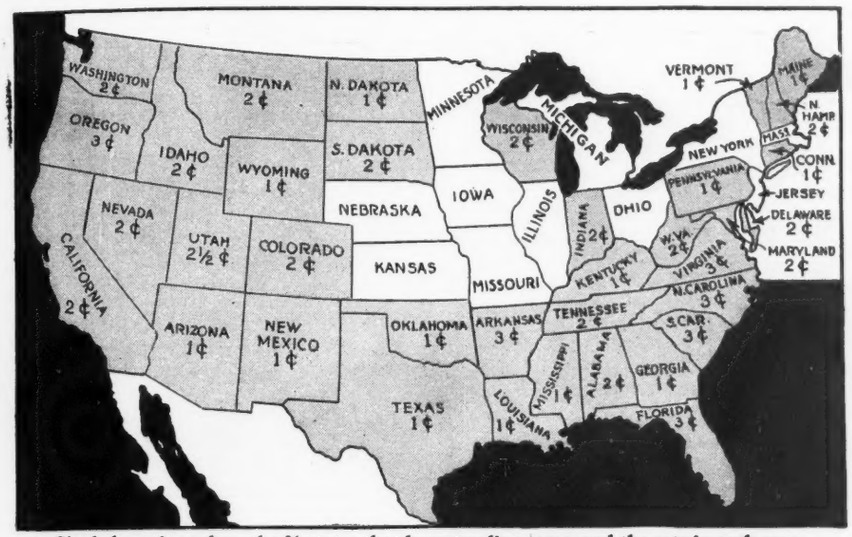
Since in the states that levy a tax on gasoline about 6,000,000 cars are registered, using at a conservative estimate 2,604,000,000 gallons of gasoline a year, about $50,000,000 will go to the treasuries of the states every 12 months from automobile owners, or more than eight dollars a year for each car.

The only states that do not tax gasoline are Massachusetts, Rhode Island, New York, New Jersey, Ohio, Minnesota, Iowa, Missouri, Illinois, Michigan, Nebraska, and Kansas.

Michigan legislators passed a bill providing for a two-cent tax, but the bill was vetoed by the governor. In Massachusetts the legislature authorized a two-cent tax and the bill was signed by the governor; but a protest from the required number of citizens led to the suspension of the new law until the voters express their will in a referendum in 1925.

Seven gasoline tax bills have been introduced in a single session of the Ohio legislature, but the question of imposing a tax has been referred to a special committee for investigation. Minnesota has passed a law authorizing a constitutional amendment that will make possible the imposition of a gasoline tax in the future. The Arizona legislature sought to increase the present tax of one cent a gallon to three cents, but the bill was vetoed by the governor.

The states that now levy the tax and their present rates, are shown in the shaded portions of the map.



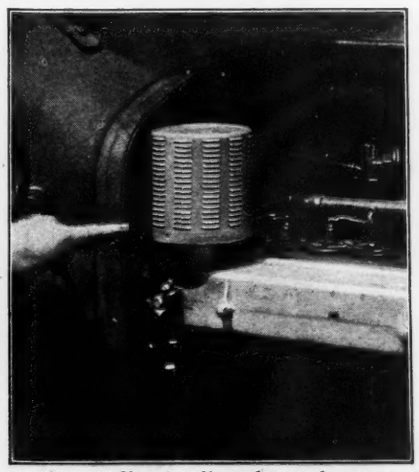
Shaded portions show the 36 states that have gasoline taxes, and the rate in each case

Air Filter for Carburetor Saves Repair Bills

A "FELT throat" for carburetors is said to keep practically every bit of dust and grit from entering the engine through the air intake. The air filter can be fitted over this intake in various ways, according to the make of car and type of carburetor, so that all the air consumed by the carburetor first passes through a series of thick felt pads.

As the pads catch the grit the excess dirt shakes off through the bottom of the filter. The device is inclosed in a specially perforated outside shell drawn from sheet aluminum and is equipped with a flexible hose of galvanized steel.

The device, it is claimed, also controls the temperature of the air, muffles carburetor noises, and greatly reduces carbon deposits in the engine. It is said to provide positive protection from gritty oil, which causes scored cylinders, burned-out bearings, and large repair bills.



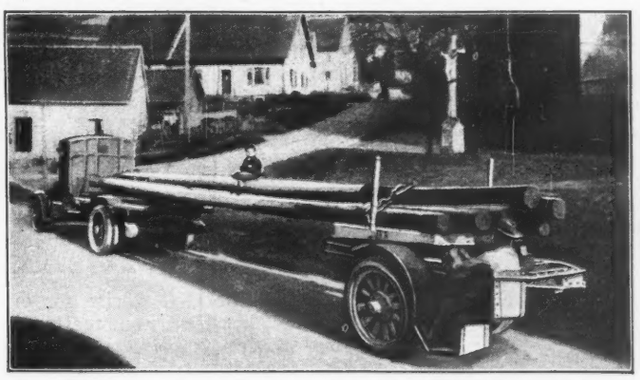
How air filter is adjusted to carburetor

Long, Trailing Loads Steered at Both Ends

LONG, trailing loads, always difficult for the truck-driver to manage, are handled with ease by a new Belgian trailer that has a side seat attached to the rear trucks. From this a second driver steers the rear end from the left-hand side of the load.

The idea is similar to that employed on fire towers and ladder apparatus in modern fire departments, except that the seat is placed beside the load and slightly below it, instead of above it.

The photograph at the left shows a truck with the new steerable trailer hauling a load of long telegraph poles through the narrow, tortuous, streets of a Belgian town. Notice the small boy taking a free ride.



A second driver at the rear trucks aids in steering the load

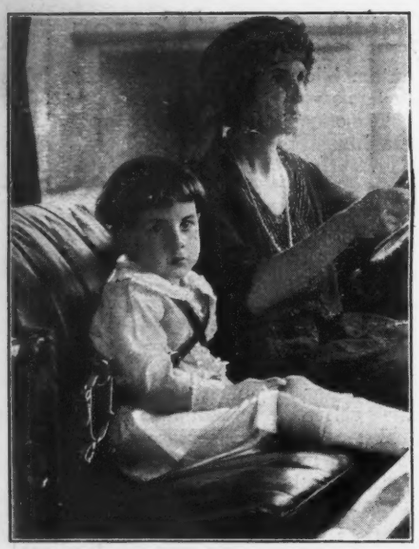
Valve Adjustment Made Easy for Motorists

BY USING a newly invented valve-adjusting dial, any car-owner is said to be enabled to adjust his own valves—a job that the average mechanic often does wrong—and to have a motor that neither rattles, clanks nor pounds.

Each notch on the knurled dial represents one thousandth of an inch. Simply by turning this with the thumb and finger, the car-owner can make the finest adjustment. By keeping the valve clearance just right, he can save gas, increase power, get the highest motor efficiency, and save bills for replacing valves burnt out from improper adjustment.

A gage is furnished with every set to show the correct valve clearance. The adjusters are available for 13 standard makes of cars.

The valve is adjusted by knurled dial



Belt Holds Child Safely in Automobile Seat

WHEN the baby is bouncing around on the seat beside her, threatening at any moment to fall, no mother can give her undivided attention to the steering-wheel. To enable her to be a better driver, a belt has been invented that holds children from one to eight years of age in a comfortable position on the front seat of an automobile.

It passes around the child's shoulders and across the chest, then is fastened at the back to the seat. It can be clamped quickly or released from the front seat. The child is thus prevented from climbing out of the seat.

Know Your Car

WHETHER your car is in continual use or not, it should be cleaned at regular intervals. Cool water is best always, though cold water applied when the car itself is in a cold place may injure the varnish. Never wash the car in bright sunlight or turn the hose on the body directly or under pressure. The stream should be transformed into a spray or the nozzle removed. Use clean water and change it frequently.

The top should be cleaned first with tepid water, using Castile soap if the dirt is thick, and drying with chamois skin. The body should be washed with the sponge dripping wet, allowing the excess water to run down the panels in order to loosen the dirt so that it will wash off more easily.

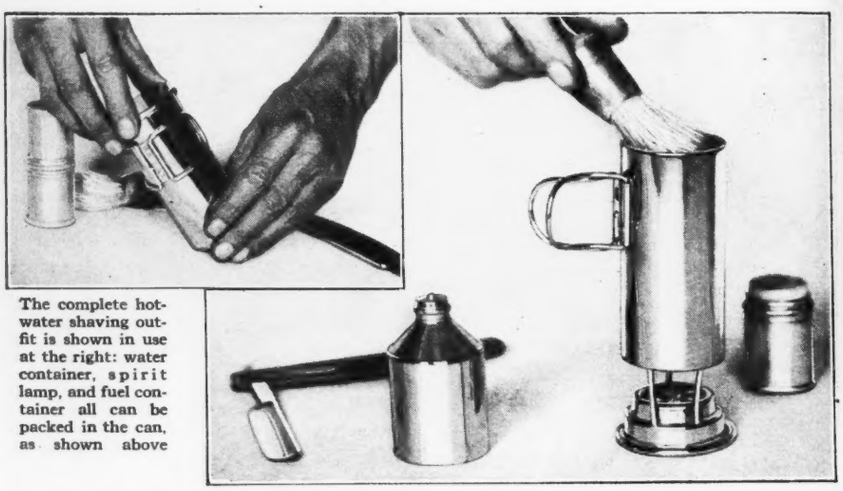
If the mud is caked on to the finish, don't try to rub or scrape it off. Let a slow stream of water run over it and soak it off. After this preliminary, a new sponge and clean water should be used for a second washing.

The car should be dried by using a damp chamois skin which has been rinsed in clear water and wrung nearly dry.

A Hot-Water Shaving Outfit for Travelers

HOT water for shaving anywhere, any time, is the luxury available for the man who carries a new compact water heating set and shaving outfit in his traveling bag. The set consists of three pieces—a small spirit lamp, a can for extra fuel, and a cylindrical can that fits the lamp and in which the water is boiled.

The water container, fitted with folding handles, is just large enough for the shaving-brush to be immersed. The whole outfit is very compact, the lamp and spirit container both folding up into the cylinder.



The complete hot-water shaving outfit is shown in use at the right: water container, spirit lamp, and fuel container all can be packed in the can, as shown above

New Anti-Glare Spectacles for the Motorist

EYE shades in spectacle form are the latest in anti-glare shields for motorists. The eye-pieces in the upper half of the frame are made of a semi-transparent unbreakable material in green or amber, while the lower half is empty.

IRON staircases in the library of the British Museum recently were given a coat of rust, by means of chemicals, to make them less slippery and so safeguard employees.

Red Best for Signals

RED, the traditional danger signal, proved itself to be the most easily distinguished of all colors at a distance, in recent tests for visibility of traffic signals conducted by the U. S. Bureau of Standards. Green came second, while blue ranked a poor third. Ordinary railroad yellow lights, it was found, often are mistaken for orange or red.

The observations were made at distances of 600, 900, and 1250 feet.

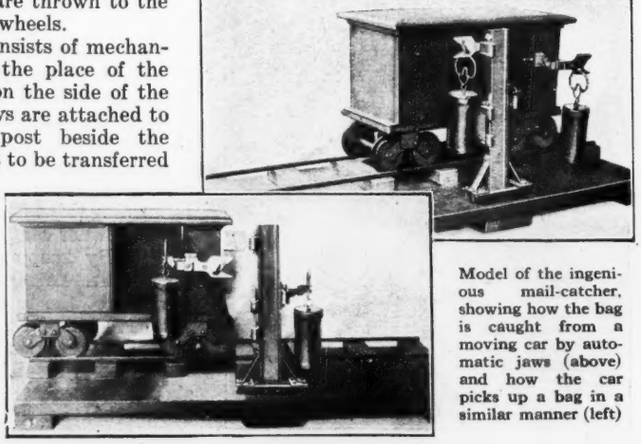
Automatic Jaws Catch Mail from Trains

A MAIL-CATCHING device for exchanging first class mail matter to and from moving trains has been designed so that it works automatically without the attention of clerks while the mail is being transferred "on the fly." It also does away with damage done to the mail when bags are thrown to the ground or under the wheels.

The new device consists of mechanical jaws that take the place of the familiar iron hooks on the side of the mail car. Similar jaws are attached to a newly designed post beside the tracks. When mail is to be transferred from a moving train, the bag on the car is hung on its holder by means of a ring. In passing the mailing post the ring is caught by the jaws and the bag thus transferred.

A bag hung on the post is caught in like manner by the jaws on the car and immediately swung inside.

The entire operation may be set in advance without needing further attention from the clerks.



Model of the ingenious mail-catcher, showing how the bag is caught from a moving car by automatic jaws (above) and how the car picks up a bag in a similar manner (left)

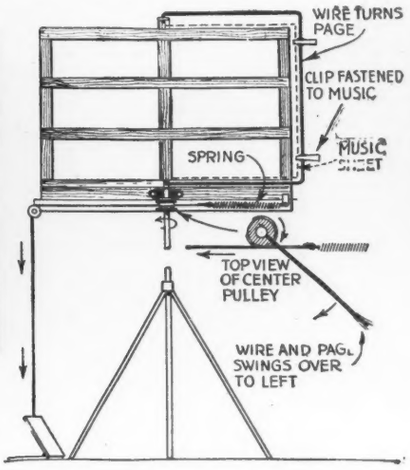
Automatic Attachment Turns Music Pages

THE troublesome task of turning the pages of a music score and thus interrupting the playing is done away with by a recently patented music-turner that may be adapted to either the piano or music stand.

For the former, the device consists of a rack with turner attachment, consisting of a wire frame with clips that hold the page to be turned. This device is connected with an attachment under the keyboard and operated by the player's knee. The operating connection is made by means of cord and two pulleys fastened at the end of the piano.

Pressure of the knee against the attachment pulls the cord. This pulls a music clamp, which turns the page.

The apparatus may be used on a music stand by attaching the pedal to the base, and running the cord along the bottom of the rack.



The knee control attachment for turning pages at the piano is shown above. The diagram at the right explains the operation of the device when applied to a music stand. Clips on a wire frame are fastened to the page of music which is turned by pressing a pedal

THE fact that diamonds cling to lubricating grease in water, while pebbles and semi-precious stones roll off, has been made the basis for a new machine called a "pulsator," which picks diamonds out of material in which they cannot be seen by human eyes.

Rubber Skin Saves Fruit

A PRACTICAL new process for preserving tropical fruits, other than bananas and pineapples, so that they may be shipped long distances, recently has been discovered. The fruit, gathered a little before it is ripe, is smeared with a thin coating of rubber latex which, when coagulated, forms a protective skin. The process of ripening is slowed up, it is said, keeping the fruit in good condition.

Headband Visor Designed for Tennis Players

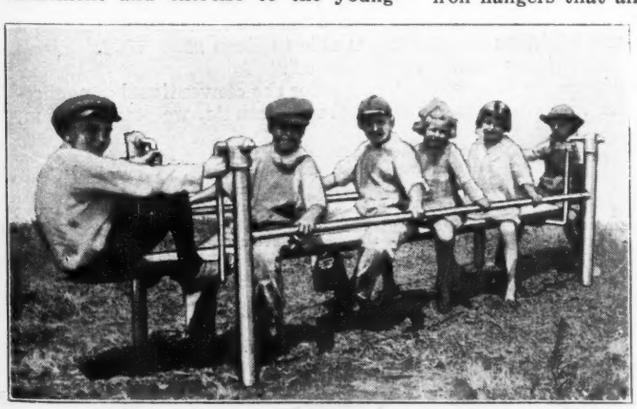
FOR tennis enthusiasts and other sportsmen, an athletic visor headband has been designed to keep hair and perspiration from the face. It consists of a broad elastic band that fits any size head, with a visor to protect the eyes from the sun. This visor is lined underneath with green, which is restful to the eyes in the glare of the sun.

Ten Children Can Ride on "Seesaw" Swing

A NEW type of outdoor swing for children, known as the "rock-a-bye" swing, is said to afford a great deal of amusement and exercise to the youngsters. Almost any one could build it.

It consists of a plank capable of holding 10 children. The plank is suspended on iron hangers that allow it to swing back and forth. Bars at each side enable the children to stop or start the swing at will. A safety catch keeps the board from being swung too far for safety.

The apparatus is made of galvanized pipe so as to withstand the roughest treatment from the children and all kinds of weather. The pipe can be joined easily.



How the "seesaw" board is slung from pipe supports

Small Charcoal Stove Can Be Carried in Auto

ANY food that may be broiled, boiled, or steamed can be prepared on this convenient new steel camp-stove, which burns charcoal for fuel. Its total height is only seven inches, so that it may be packed easily in the automobile. Utensils for steaming and boiling are placed on top of the stove.

A foot pump helps provide a draft to get a good blaze started. The metal case in which the stove is carried contains, also, a compartment for extra fuel. Five cents' worth of charcoal is said to be sufficient to cook a good meal for six persons. After the meal the stove can be packed away quickly.

How Much Do You Know about Science?

THE following 12 questions dealing with fundamental facts of science were selected from thousands of queries that have come from our readers. How many of these facts do you know?

Answer the questions to the best of your ability, then turn to page 149 and see how nearly you were right. A dozen more questions will be published in next month's issue.

1. How does a submarine keep from turning over under water?
2. When does the heart rest?
3. Why does it not hurt to cut our hair or our finger-nails?
4. How many different chemical elements are there?
5. Why is snow white?
6. What is the metric system?
7. Why do wires have to be used to carry electricity?
8. How far is the farthest star?
9. Why can't you skate on glass if it is smoother than ice?
10. Why do we know that the earth is not made of rock all the way through?
11. Why do hard lumps of clinkers form in a furnace?
12. What is a magnet?

How I Lead the Greatest

The Remarkable Story of a Physical Director Who Gets

ANY morning at seven, if you tune in Station WOR at Newark, N. J., you will hear the voice of A. E. Bagley, physical director of the Newark Y. M. C. A., leading the setting-up exercises of the most remarkable gym class in the world—an invisible radio class numbering anywhere from 50,000 to 500,000 persons.

This is the story of how he does it, told in his own fascinating way, and containing many useful hints that you can apply for better health and greater happiness.

By A. E. Bagley

THERE was a song that was very popular during the war, especially in the training-camps. It represented a sleepy doughboy paying his respects to the bugler whose call awakened him at dawn or thereabouts.

Some day I'm going to murder the bugler;
Some day they're going to find him dead!
I'll amputate his "Réveillé,"
And step upon it heavily,
And spend the rest of my life in bed!

That's the way the song ended. No doubt you remember it.

Of course, it was a comic song. And yet I suspect that many persons who heard it, and not a few who sang it, took the sentiment it expressed more or less seriously.

For there long has existed an opinion that the most cordially hated thing in the world is an alarm clock; that the great majority of people would be supremely happy and perfectly contented if only they were permitted to stay in bed every day as long as they pleased.

You can't prove it by me! On the contrary, I'm ready to raise my right hand and my voice and tell the whole listening world that people do *not* "hate to get up in the morning," as the song I just quoted had it. They *like* to get up, and they do it cheerfully and willingly.

I HAVE always had that opinion. Many years of conducting gym classes convinced me that the average person is by no means as lazy as is generally supposed. And how I know that I'm right is because about 50,000 entirely representative Americans and not a few Canadians have told me so in the last few months. Moreover, those 50,000 practise what they preach, for they and at least double as many others, living between New Brunswick on the north and Georgia on the south, and central Ohio on the west and the Atlantic coast on the east, for almost half a year have been getting up at the stroke of seven every morning except Sunday to let me direct them in physical exercises over the radio.

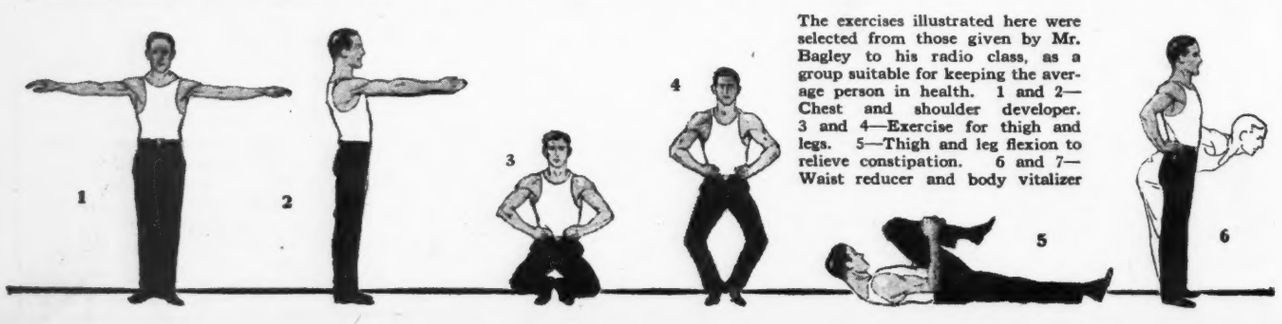
Mine is the world's largest gymnasium class. Just how many members it has, I do not know. There are 50,000 anyway, because I have received letters from that many. At the WOR radio station in Newark, N. J., from which I conduct the exercises, it is estimated that letters ordinarily are received from less than 10 per cent of the listeners-in to any broadcast feature. So there may be a half-million people who go through the exercises with me every day. I hope there are—I hope there are twice that many, even though the thought of two million arms being raised and a million bodies bent as I call the commands for the exercises into the microphone rather frightens me. For it is encouraging, gratifying and stimulating to know that even the 50,000 who have written to me are willing to leave their beds earlier than was their custom and go through the exercises for the benefit of their health.

Much of the phenomenal success of the morning radio exercises Mr. Bagley attributes to the piano accompaniment played by Fred Harnett, who is pictured here

PROPERLY enough, we start proceedings by ringing an alarm clock. It's the biggest alarm clock we could find, and the sound of its bell, issuing from a loudspeaker, I'm told, is sufficient to awaken the soundest sleeper. The mother of a large family in Massachusetts wrote me:

"I used to be at my wits' end trying to get my husband and my boys and girls up in the morning. Now, though, I just get up and turn on the radio set. None of them is able to sleep after WOR's alarm clock goes off!"

Then, after the conventional announcement from the studio, we start the fun,



The exercises illustrated here were selected from those given by Mr. Bagley to his radio class, as a group suitable for keeping the average person in health. 1 and 2—Chest and shoulder developer. 3 and 4—Exercise for thigh and legs. 5—Thigh and leg flexion to relieve constipation. 6 and 7—Waist reducer and body vitalizer

Gym Classes in the World

Thousands of Folks Up at 7 O'clock to Exercise by Radio

for that's exactly what I try to make the exercises. The one thing I want to avoid is having my "early birds" look on their morning exercises as a painful duty, for exercise, taken as a duty, loses half its beneficial effects. So, when I can, I tell a little joke, or indulge in a little nonsense to liven things up. We use the studio props—"crickets" and other noise-making contraptions—to represent creaking joints or splitting pajama legs while we're doing bending exercises. The other morning I told the class I was going to carry the piano up to the studio roof so that the radio operator could do the exercises with us. With the aid of "glass crashes," thumps on the floor, grunts, and a lively conversation which I conducted with an imaginary janitor who apparently objected to my removing the piano, we managed to produce quite a convincing little comedy for our hearers' benefit.

Also, the exercises are all done to music. Fred Harnett, a young Newark business man, is my volunteer pianist, and his lively tunes supply in great part the explanation of why at least 50,000 people have become convinced that it is easy to insure their physical health and have a good time simultaneously.

"The thought of thousands of arms being raised and thousands of bodies bent as I call commands for exercises into the microphone, rather frightens me." Mr. Bagley confesses. Here he is at the microphone of Station WOR, leading the world's greatest gym class to piano accompaniment

I can't take the space to describe the exercises we do. The little sketches that accompany this article probably will explain them adequately. Try some of them for a few mornings and see how much better it will make you feel! Tune in on us if you can. If not, whistle a tune, or sing one, or put a record on your talking machine while you swing your arms or bend your legs. At all events, make your exercise play, and not work.

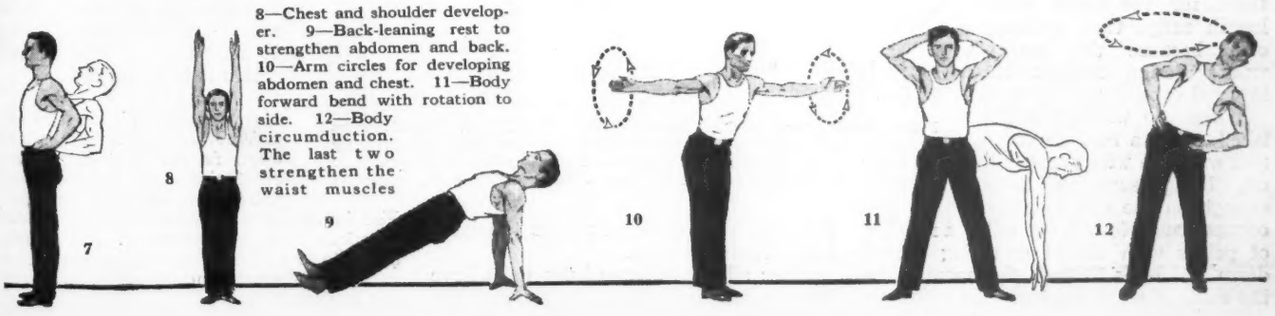
THAT'S about all there is to my big gym class, except that twice a week I give a brief talk on various phases of diet and exercise—how they may be employed, for example, to improve the digestion, to reduce or increase the weight, to cure round shoulders, flat chests, or flat feet.

That last may be worth noting here, for most people, I believe, are of the opinion that there is no cure for flat feet; that the best that can be obtained is relief through arch supporters, or similar appliances. This is far from being the case. If you have flat feet, you can correct them, as I've told my early birds, by simple exercises you can perform while you're putting on or taking off your clothing.

While you're removing your collar, say, walk around your bedroom on the outer edges of your feet with your shoes off, or try to seize some round object—a tennis ball, for example, or the rung of a chair—by closing your foot around it. A few weeks of this, and, unless yours is a particularly aggravated case of broken arches, you'll probably find the natural arch of your foot reappearing in a most astonishing way.

BUT let's get back to the gym class. As I said before, I've received some 50,000 letters from my early birds. All of the letters I've read, many I've replied to. In the main, they have supplied the most interesting reading it was ever my good fortune to encounter. The writers have been rich and poor, young and old, men and women. They have ranged from the president of one of the largest public utility corporations in the country, who wrote me a week or so ago to thank me for having reduced his weight 10 pounds, to a boy of 10, who, just after the World Series, wanted to know if I could guarantee that exercising every morning would make him "as good a pitcher as Walter Johnson."

(*Continued on page 148*)



8—Chest and shoulder developer. 9—Back-leaning rest to strengthen abdomen and back. 10—Arm circles for developing abdomen and chest. 11—Body forward bend with rotation to side. 12—Body circumduction. The last two strengthen the waist muscles

How to Make Low-Loss Coils

Easy and Efficient Ways to Do a Difficult Radio Job

By Alfred P. Lane

FIVE cents' worth of 20-penny nails, a piece of board, a No. 12 twist drill, and a supply of wire are all the supplies you need to make your own low-loss coils. And such coils, of the basket-weave type, often will greatly improve a radio receiving set. This is particularly true if the coils now in your set are wound on heavy cores or if the wire itself has been coated with shellac or other insulating compound.

No fixed dimensions are required for low-loss coils to give the best results, and this lack of limitation in size helps the home constructor, for it is often desirable to make the coil of some special dimension to fit the design of the receiver you make.

In starting the winding of a coil, first you must decide on the diameter, bearing in mind that as a rule it is not advisable to make the coil too small.

COIL *A* in Fig. 1 was wound around 15 nails set in a circle four inches in diameter. The circle was drawn on a seven-eighth-inch board and 15 equally spaced holes were drilled with a No. 12 drill on the circumference of the circle. In drilling the holes, be careful to hold the drill in a vertical position; otherwise the nails, when pushed through the board, will slant.

Nail diameters vary considerably, and since it is necessary to have them fit tightly in the holes, you probably will have to discard several nails out of a handful because they are so large that they cannot be pushed through the holes or so small that they wabble around.

After you have fitted the nails in the board, you are ready to start winding. The rule may be stated simply: Around two; skip two. Figure 2 shows the first turn around the nails. Continue winding in the same fashion until you have the number of turns you need. Remember that basket-weave coils require more turns for the same wave-length range than ordinary coils because the basket-weave design reduces the internal capacity of the coil.

When the winding is finished, make a turn around a nail with the wire and cut it off, being sure to leave enough on the end to make connections. Now tie the coil at a number of points with thread or string passed down and back through the openings in the coil. A short piece of wire with one end bent or a crochet needle will make this easy to do.

It is possible now to pull the whole coil off the nails, but it is better to pull out the nails, one at a time, with a pair of pliers. Otherwise you will be almost sure to bend the coil out of shape or scrape the insulation from the wire.

After all but a few of the nails have been pulled out, you will find that the coil can be lifted from the remainder of them. The next step is to fasten the coil permanently with silk thread. A good way to do this is to use a long needle and sew the thread back and forth, as shown in Fig. 4 at foot of page.

The number of nails is not necessarily fixed at 15. You can use a larger or a smaller number, provided you choose a number that will result in the staggering of the turns of wire so that a symmetrical winding can be made. Also you do not have to stick to the formula, around two; skip two. Another way is to go around one and skip two. Figure 3 illustrates the first turn by these two methods.

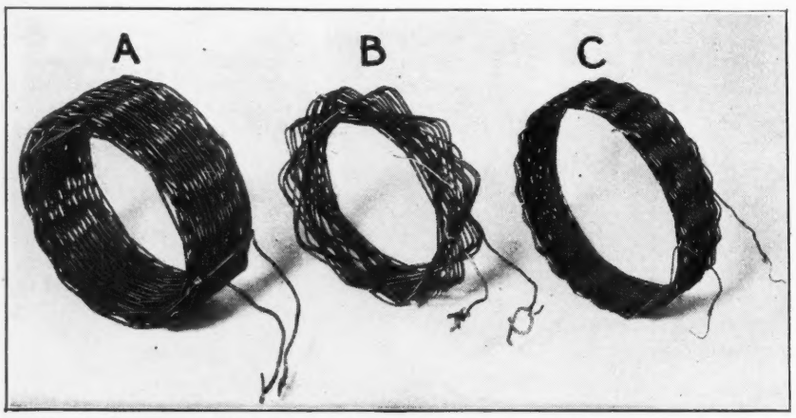


Fig. 1. Three types of low-loss coils made by the basket-weave method. *A* is wound on 15 pegs with No. 16 double silk-covered wire. *B* is wound on 11 pegs with No. 18 double-silk covered wire and *C*, on 22 pegs with No. 22 double silk-covered wire

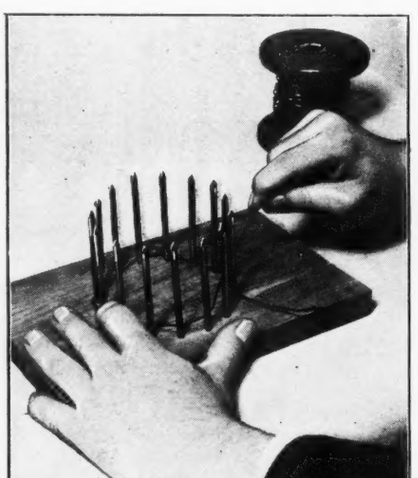


Fig. 2. How the nail pegs are arranged in the board. The picture shows the first turn of wire around 15 nails being completed

COIL *A* in Fig. 1 was wound by the first method of No. 16 double silk-covered wire, while coils *B* and *C* were wound by the second method. The correct number of nails for one system of winding does not always work with the other, but it is a simple matter to draw the circle first on a piece of paper and go around the proposed number of nails with a pencil line, and you will quickly see whether the winding comes out right or not.

Coil *B* was wound around 11 nails with No. 18 wire, while coil *C* was wound around 22 nails, using No. 22 wire. This last coil is plenty strong enough to use as an inductance with only a clamp to hold it in place.

Aside from the fact that basket-weave coils have extremely low losses, they have other points of advantage. They are so rigid that it is easy to make two coils, one larger than the other, and mount one inside the other as a radio-frequency transformer, or to arrange matters so that the smaller one can be rotated. The latter scheme will result in a variocoupler or variometer of high efficiency.

SOLDERING taps to a basket-weave coil at almost any point is easy, for the spacing of the wire is such that it is necessary only to scrape the insulation off where it is to be tapped.

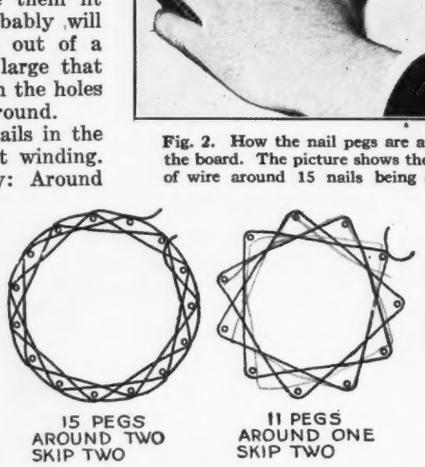


Fig. 3. Two ways of winding low-loss coils. The method at the left was employed in winding coil *A* in Fig. 1 on 15 nails. The method at the right was used in winding coils *B* and *C*

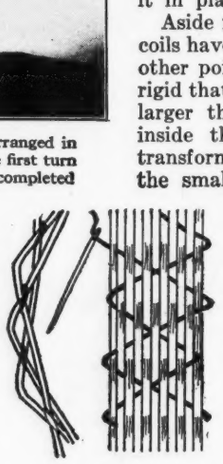


Fig. 4. How the wires are bound together by silk thread sewed back and forth, crisscross

In constructing radio receivers, the amateur these days is turning out work that rivals the professional job in mechanical efficiency. Yet in appearance the amateur set, as a rule, could be improved. An article on page 90 of The Home Workshop this month, tells how you can dress up your set to give it "style."

Will Super-Power Replace Super Receiving Sets?

Three new plans for developing broadcast transmission—What the new year promises you in radio progress

By Jack Binns

America's most popular writer on radio

WHAT is going to happen in radio during 1925?

Nearly every fan has been asking this question; for he wants to know just what kind of a set to buy or build, what kind of broadcasting will be on the air, and what kind of reception he may expect.

During the past three years, radio development has been largely in the realm of reception, along the lines of improving receiving equipment. Now every indication points to a reversal of the order. Instead of more elaborate super-receivers to pick up and magnify weak signals, the trend is toward super-broadcasting with power increased so that distant signals can be brought in by even the simplest receivers.

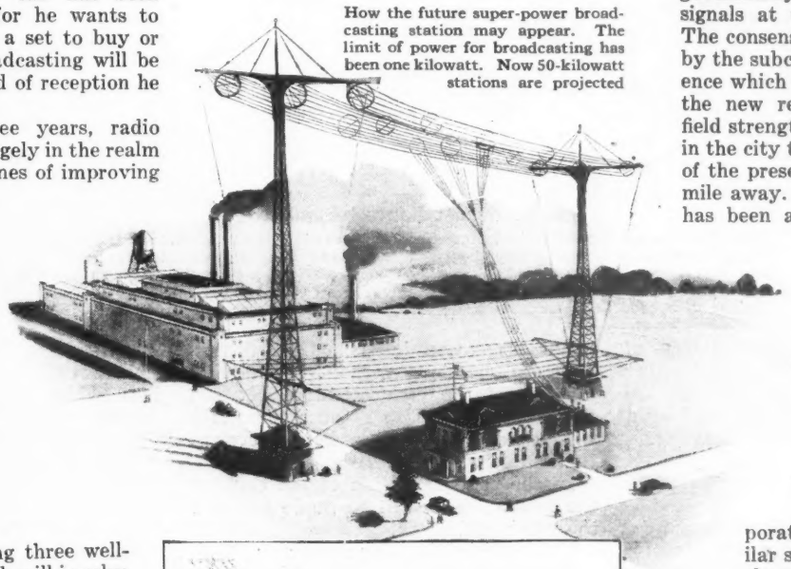
The development of transmission during the year will be along three well-defined lines, two of which will involve super-power. The third is national broadcasting through the interconnection of broadcasting stations by means of telephone land wires. All three systems will be experimental in character at first, proceeding according to recommendations of the recent Third National Radio Conference in Washington, D. C. Thus, the use of super-power will be subject to immediate cancellation, should the fears of those who say it will tend to create a monopoly of the air materialize.

The three plans of transmission are so vital to every owner of a radio set, that I shall outline here what is contemplated in their development.

Up to Fifty Kilowatts

THE first plan under the super-power scheme involves the erection of high-powered broadcasting stations at points removed from any thickly populated area. Such stations will be connected with studios in the large cities by means of land-line wires. The first station of this character will be erected by the Radio Corporation of America at some point within 50 miles of New York City; not necessarily in New York State. Just what amount of power may be employed has not yet been decided definitely.

Under the regulations laid down by the U. S. Department of Commerce, such a station may employ as high as 50 kilowatts and will operate under an experimental license. This means that the license may be revoked at any moment by the Secretary of Commerce should the operation of the station prove to be a source of interference with other existing forms of radio communication or broadcasting.



How the future super-power broadcasting station may appear. The limit of power for broadcasting has been one kilowatt. Now 50-kilowatt stations are projected

The amount of power employed will be governed by the field strength of the signals at the nearest large city. The consensus of opinion expressed by the subcommittee at the conference which determined the basis of the new regulations, is that this field strength should not be greater in the city than is the field strength of the present Class B station, one mile away. While no definite plan has been announced, it is understood that the Radio Corporation will experiment with various degrees of power as soon as the new station is erected.

In connection with the development of the super-power plan along these lines, should the experiment prove successful, the Radio Corporation intends to erect similar stations in other parts of the country, so that a complete national broadcasting system can be developed. Such super stations probably will be arranged so that all can be connected with a single program by means of radio relays.

Many of the independent broadcasters also have announced their intention of experimenting with the super-power idea, and a plan has been formulated to interconnect these and at the same time develop an association for universal programs.

A Wider Broadcast Wave Band

Increase in the broadcast wave-length band to include waves up to 550 meters and down to 200 meters means that if you are planning to buy or build a new set, you should make sure it will tune in all broadcasting stations within these new limits. The purpose of the increased wave-band is to relieve congestion of the ether.

High Power on Short Waves

THE second system of super-power broadcasting involves the use of short waves far below the range of present-day receivers. This is the system that has been developed by the Westinghouse Company at KDKA in Pittsburgh, and KFKX in Hastings, Neb. The success of experiments already made have led to the belief that a considerable portion of the world can be linked to one program by means of this system without interfering in any way with the existing local broadcasting stations.

The latest experiment was in connection with the Firpo-Wills fight when the newspaper *la Nacional* of Buenos Aires put in a special short-wave receiver and reproduced the short-wave

broadcast of the ring battle from KDKA. The short-wave transmissions of the latter station are received in England and rebroadcast in that country.

It is understood that with this system, power as high as 100 kilowatts can be employed, making it possible to cover North and South America, Europe, and the Far East.

Vast Network of Stations

THE third system is the inter-connection of all existing broadcasting stations by means of a network of land-line telephone wires. The success of this system during the last year in broadcasting events of national importance to all corners of the country is familiar to every radio fan.

The National Defense Day address of General Pershing, which was heard the length and breadth of the land, and the speech of President Coolidge on the eve of Election Day, when 25 broadcasting stations were joined as one, are striking examples of what may be achieved by a vast national network of broadcasting.

A New Zoning System

ANOTHER important development in broadcasting that will affect every radio fan during the coming year is the re-zoning of the country in accordance with recommendations made to Secretary of Commerce Hoover by the Third Radio Conference.

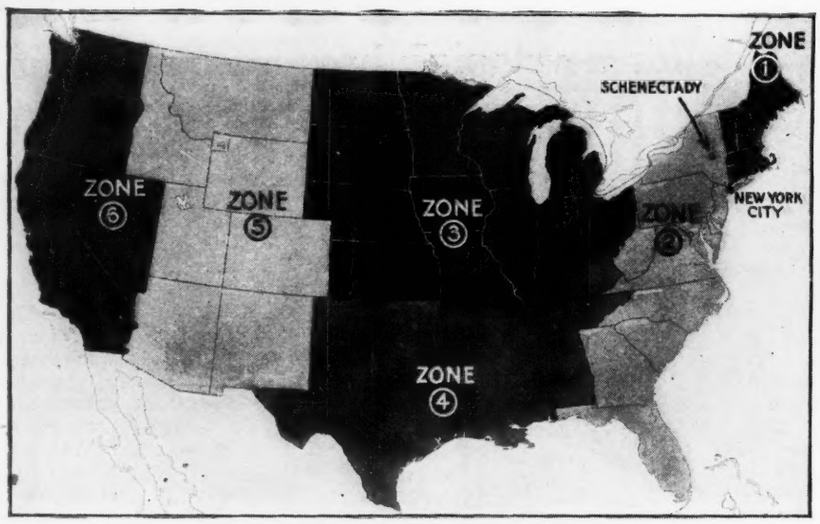
Under the new plan the country will be divided into six zones, instead of five, as at present. The material changes are that the northeastern Atlantic States will have stations operating on the same wave lengths as stations in Pacific Coast States. This can be done without interference because of the great distance between the stations and also because there is a time difference of three hours between the two coasts.

In the central portion of the country the zone division will be made between the north and south.

The new broadcasting zones are:

Zone 1: New England, New York City, and Schenectady. Zone 2: Atlantic coast, Metropolitan District to Florida. Zone 3: Northern central states. Zone 4: Southern central states. Zone 5: Rocky Mountain states. Zone 6: Pacific coast states.

The new regulations are a recognition of the fact that the tremendous increase in the number of first class broadcasters during the past year has necessitated duplication of wave-length assignments on both coasts.



Six Broadcast Zones instead of Five

The plan of re-zoning the United States for broadcasting, as recommended by the Third National Radio Conference. The country would be divided into six broadcast zones instead of five, as at present. Some of the stations in the northeastern Atlantic States would have the same wave lengths as stations on the Pacific Coast, the distances between them preventing interference. Notice that Schenectady and New York City are included in Zone 1

Wave Changes

THOSE fans who own receivers that permit "logging" of dial settings will have to hunt all over again as soon as the new wave length changes go into effect. All broadcast stations will be reclassified. The present Class A, including stations originally assigned to 360 meters, is to be abolished. All transmitters employing less than 100 watts in power will be put within the wave band between 200 and 240 meters. Stations using between 100 and 500 watts will be placed in the wave band of from 240 to 280 meters.

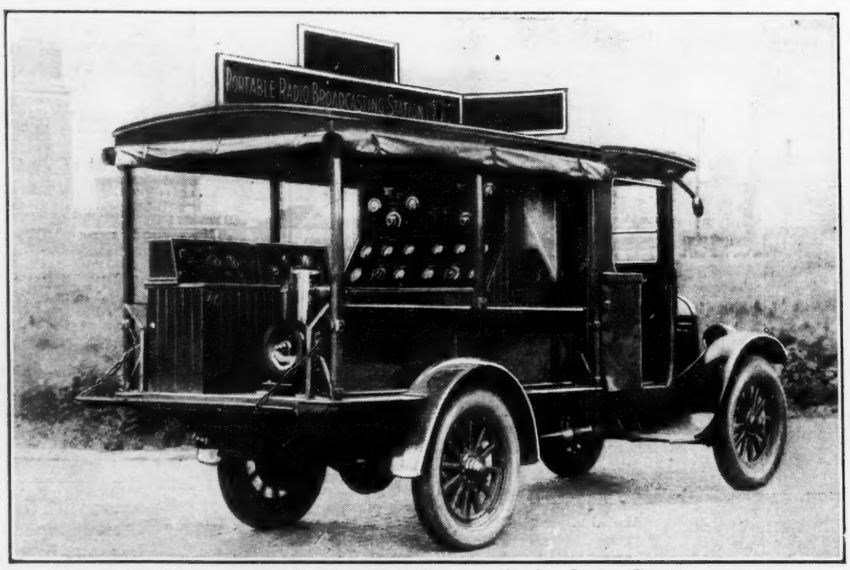
Stations using a power of 500 watts or more, formerly in the Class B category, will be assigned to waves ranging from 280 to 550 meters.

The increase in the broadcast wave-length band to include waves down to 200 meters and up to 550 meters, means that the radio fan who is buying or building a new set should make sure that it will tune in all stations within these limits.

Broadcasting Station on a Motor-Truck Makes Tests in Illinois

AN ILLINOIS radio corporation recently has been conducting exhaustive transmission tests within a radius of 40 miles of Chicago by means of a complete portable broadcasting station mounted on a one-ton truck. The purpose of the tests is to ascertain atmospheric and broadcasting conditions and peculiarities of various localities in order to determine the best location for a permanent broadcasting station of high power and wide range.

The name of the portable station is WJAZ, with a wave length of 268 meters. It is able to function without any external resources of supply, for it carries its own generating plant, complete broadcasting and receiving equipment and collapsible mast and antenna. A gasoline engine operates a generator while the station is broadcasting so that transmission may be continuous.



Station WJAZ, a complete broadcasting plant on wheels. It supplies its own power

The set is of 100-watt power and it uses four 50-watt tubes. The entire truck is electrically lighted from its own power plant. The antenna mast reaches 53 feet, while the antenna consists of four heavily braided copper cables with extremely fine wire. The entire framework and body of the truck are grounded at the side of the truck.

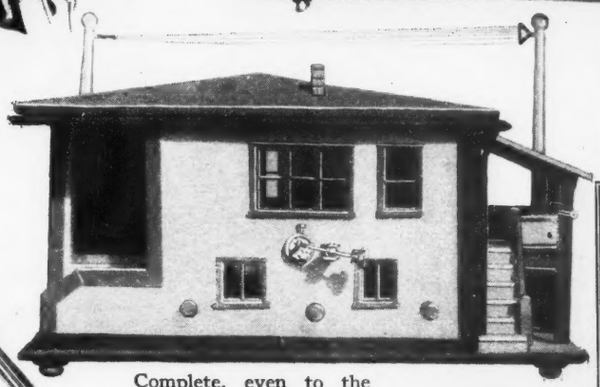
Only 10 minutes are required to pack the outfit and have the truck under way after signing off from a program.

Radio in Its Oddest Forms

Receivers Built into Farmyard, House, and Savings-Bank

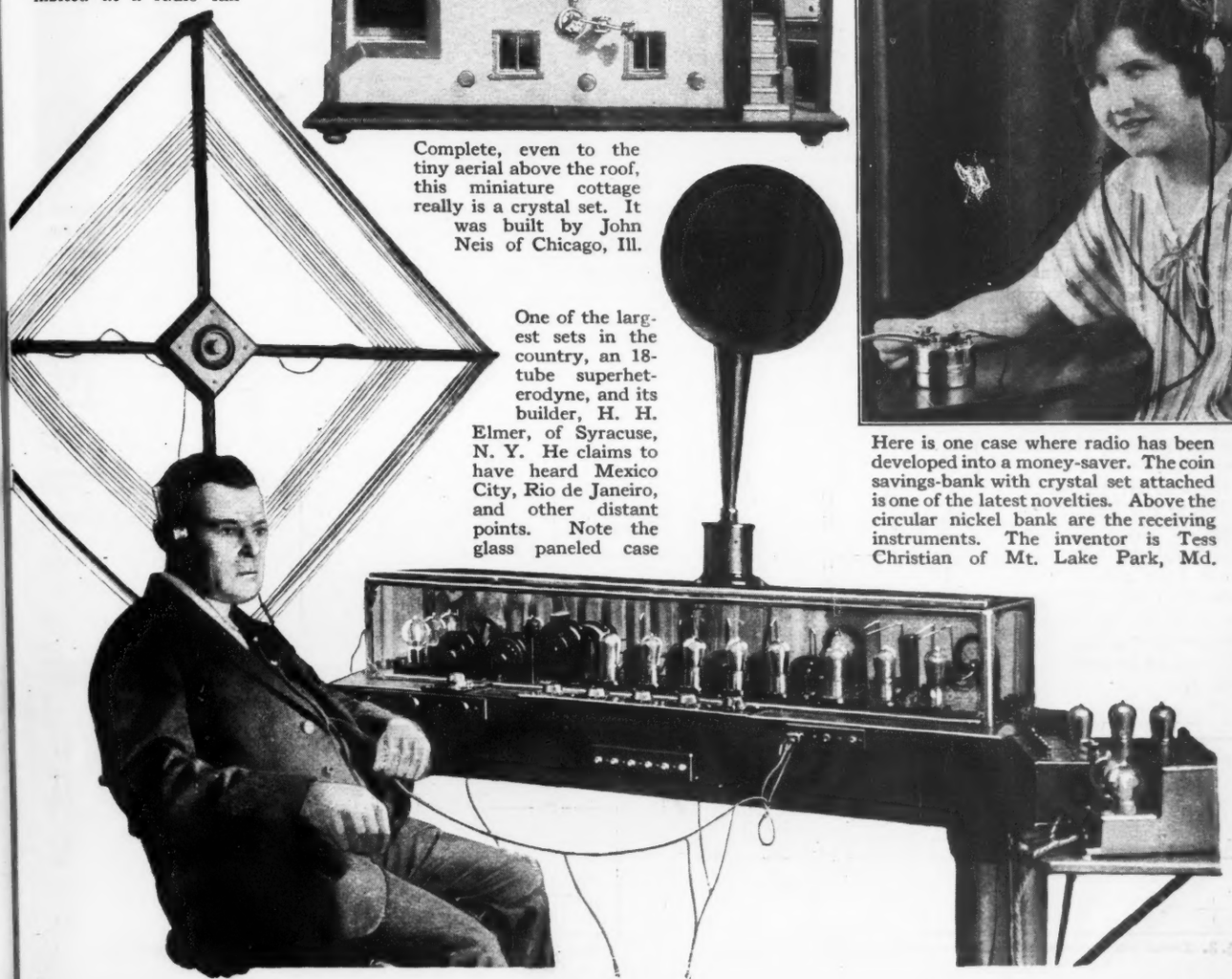
Mounted on the end of a stick like a piece of taffy, the little crystal receiver shown above has been aptly named "The Lollipop Radio Set," by its builder, William L. Wray, of New York. It was exhibited at a radio fair

A three-tube regenerative receiver is built into this picturesque rural scene. The well at the extreme right forms the loudspeaker, while the small animals, which can be turned on their pedestals, serve as the tuning dials. The builder is L. Abrams of Brooklyn, N. Y.



Complete, even to the tiny aerial above the roof, this miniature cottage really is a crystal set. It was built by John Neis of Chicago, Ill.

Here is one case where radio has been developed into a money-saver. The coin savings-bank with crystal set attached is one of the latest novelties. Above the circular nickel bank are the receiving instruments. The inventor is Tess Christian of Mt. Lake Park, Md.



One of the largest sets in the country, an 18-tube superheterodyne, and its builder, H. H. Elmer, of Syracuse, N. Y. He claims to have heard Mexico City, Rio de Janeiro, and other distant points. Note the glass paneled case

A de Luxe Three-Tube Set—1925 Model

It's So Simple that Even the Beginner Can Build It

By James S. Caulfield

ONE stage of tuned radio-frequency amplification, a regenerative detector, and one stage of audio-frequency amplification make a practical, common-sense broadcast receiver that is both sensitive to distant signals and at the same time highly selective. The circuit includes no useless frills and an inspection of the wiring diagram and the photographs of the layout of parts will show that it is simple in design.

BY SETTING the detector tickler coil *D* so that the detector circuit is oscillating, this receiver can be tuned by means of the carrier whistle, and yet it cannot radiate because the radio-frequency tube prevents the oscillations from reaching the antenna. This method of tuning is quick and easy and is preferred by many radio fans. The stage of radio-frequency amplification was incorporated because it increases the strength of weak signals and also acts to prevent radiation. Tuned radio frequency is employed because it gives a fairly even degree of amplification over the entire band of wave lengths. Other types of radio-frequency amplification sometimes amplify much more at one wave length than at any other.

Regeneration was added to the circuit because it increases the sensitivity of the detector tube and at the same time improves the sharpness of the tuning. The detector tickler coil *D* is used to cause regeneration.

Audio-frequency amplification has been added to increase the volume of sound to operate a loudspeaker.

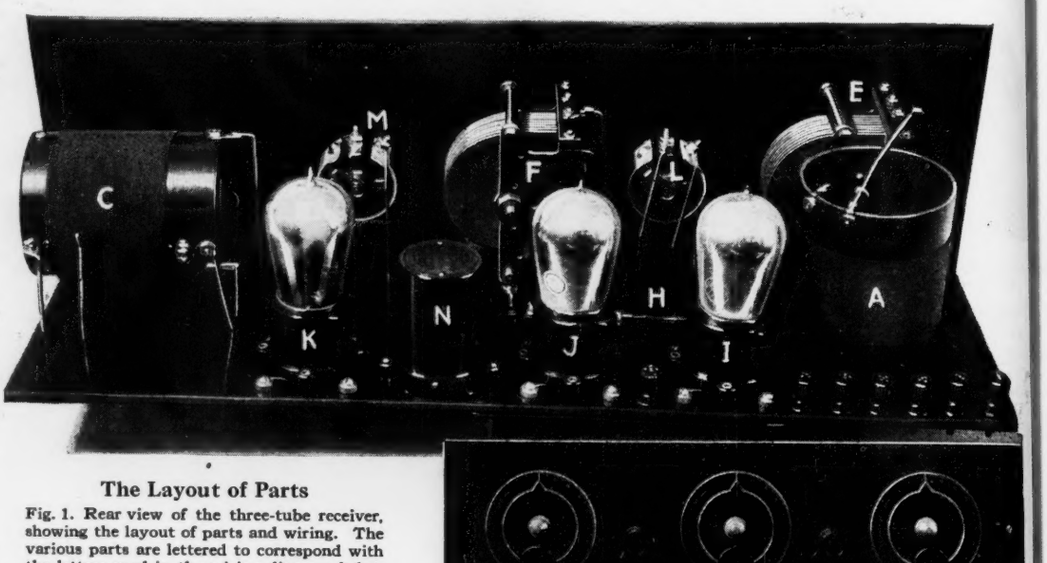
The neutralizing condenser *H* prevents the tube in the radio-frequency stage from oscillating. The conventional potentiometer often used in radio-frequency circuits is not needed.

The receiver has been designed with a sub-panel that permits concealed wiring. Sub-panel construction not only improves the appearance of the receiver, but it also reduces the time required to do the wiring, which is certainly an advantage. And it makes the wiring as direct as possible, thus reducing the length of the wires.

The binding posts have been mounted on the rear of the sub-panel so that connections can be made through the back of the cabinet. The receiver will fit the standard 7-by-21-inch cabinet.

The parts needed are as follows:

A—input coil
B—radio-frequency plate coil
C—detector grid circuit coil
D—detector tickler coil
E and *F*—variable condensers, .00035 microfarad
G—grid condenser, .00025 microfarad with clips for grid leak
H—neutralizing condenser, approximately .000003 microfarad
I, *J*, and *K*—standard sockets
L—15-ohm rheostat
M—30-ohm rheostat
N—audio-frequency transformer
O—grid leak, two megohms
P—open-circuit jack
Q—standard panel, seven by 21 inches
R—sub-panel, seven by 20 inches; seven binding posts, three dials, brackets, screws, etc.



The Layout of Parts

Fig. 1. Rear view of the three-tube receiver, showing the layout of parts and wiring. The various parts are lettered to correspond with the letters used in the wiring diagram below and in the description of the set in the accompanying article. At the right is a front view of the panel showing control dials and knobs

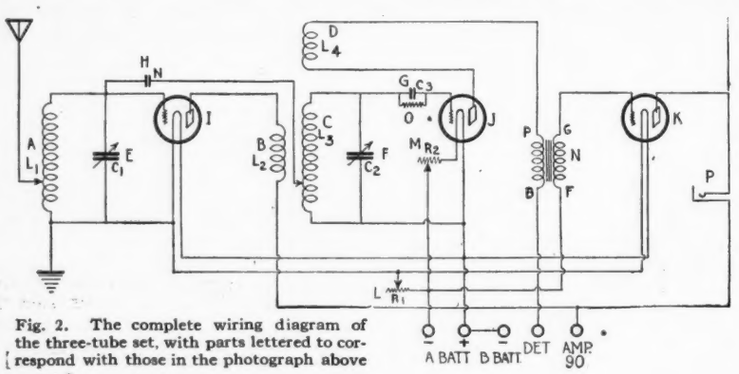


Fig. 2. The complete wiring diagram of the three-tube set, with parts lettered to correspond with those in the photograph above

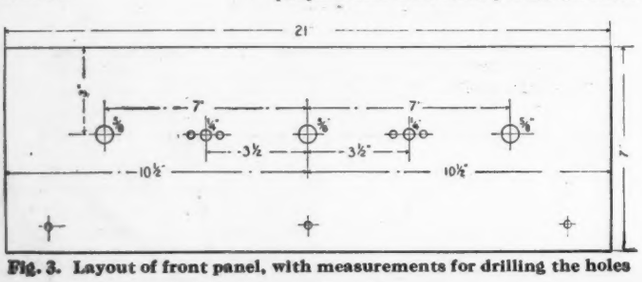


Fig. 3. Layout of front panel, with measurements for drilling the holes

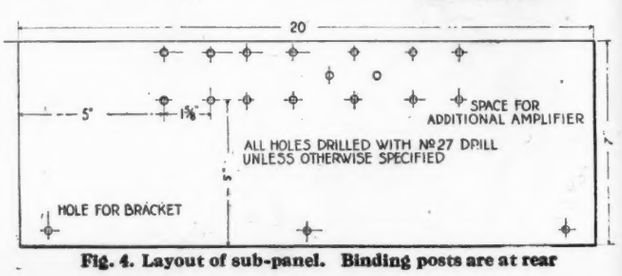


Fig. 4. Layout of sub-panel. Binding posts are at rear

High grade parts should be purchased of any standard make so long as they will fit in the space provided for them. Note that the panel layout, Fig. 3, does not include the holes for the screws that are used to mount the condensers. No two makes of condensers have the same spacing for the holes, and most manufacturers supply a paper templet so that it is necessary to know only the location of the hole for the shaft.

THE first part to construct is the input coil *A*, which is shown at the right in the rear view, Fig. 1. The form for this coil is a bakelite tube, three inches in diameter and 3¾ inches long. The winding consists of 60 turns of No. 22 double silk-covered wire. A tap should be made on this coil at the twelfth turn from the end that is to be connected with the ground. The tap is for the antenna binding-post connection.

After the coil is finished, mount it on the rear of variable condenser *E*, as shown in Figs. 1 and 6, and then lay it aside until you are ready to start mounting all the instruments.

The next operation is to construct the special radio-frequency transformer that consists of coils *B*, *C*, and *D*, as shown in the diagram, Fig. 8. Coil *B* is made by winding six turns of No. 20 double silk-covered wire on a bakelite tube 2¾ inches in diameter and 1½ inches long. The wire on this coil should be spaced one-eighth inch between turns.

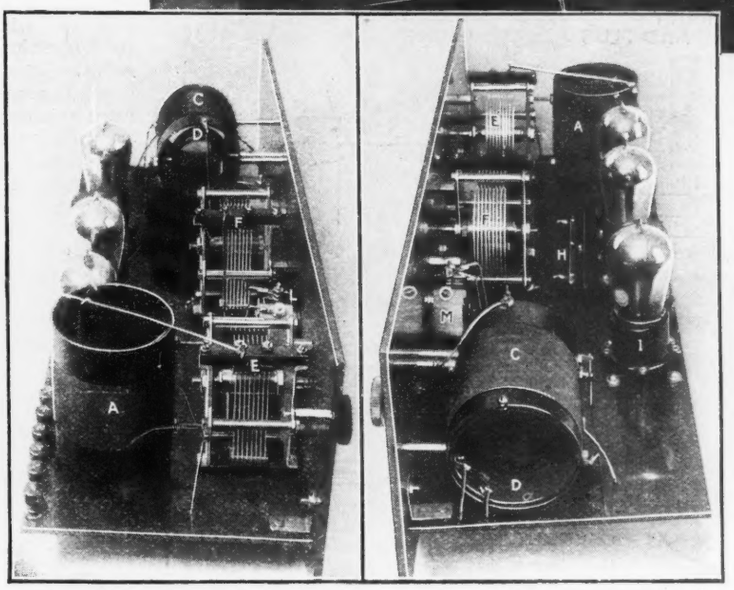
Coil *C* consists of 62 turns of No. 20 double silk-covered wire on a bakelite tube three inches in diameter and four inches long. The winding should be started about half an inch from the right end, as shown in Fig. 8, and a tap made at the sixteenth turn.

Coil *D* is made by winding 21 turns of No. 22 double silk-covered wire on each end of a tube two inches in diameter and 1½ inches long. It is necessary to divide the winding in this way to provide space for the shaft on which this coil is mounted. The dimensions of these three coils and the details of the parts needed to mount them are given in Fig. 8.

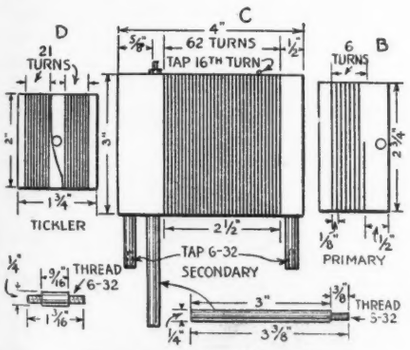
The panel and sub-panel are the next parts that must be prepared. These are parts *Q* and *R* and the layouts are given in Figs. 3 and 4, respectively. When you have finished them, it is well to fit the sub-panel to the panel and the panel to the cabinet you have selected for the receiver, for if the panel is a shade too large, it is much easier to file it down before the instruments are mounted on it. Note that there is sufficient space at the left end of the sub-panel, as shown in Figs. 1 and 7, to fit another stage of audio-frequency amplification if desired. The brass brackets necessary to mount the sub-panel can be obtained in any radio store.

Tuning In

Fig. 5. James S. Caulfield tuning in the set that he describes in the accompanying article. He begins by setting the dial controlling the tickler coil, to throw the set into oscillation. The tuning is completed by adjusting condenser dials



Figs. 6 and 7. Layout of the set viewed from each side. At left note the mounting of input coil *A* at the rear of variable condenser *E*. The mounting of detector grid circuit coil *C* and detector tickler coil *D* is shown in the right-hand view



How to Make the Coils

Fig. 8. Diagram showing how to build the tickler coil *D*, the grid circuit coil *C*, and the radio-frequency plate coil *B*. Measurements for the rotor shafts are shown in the figures that will be seen at the bottom of the diagram

AFTER you are satisfied with the fit of the panel in the cabinet, proceed to mount the instruments as shown in Figs. 1, 6, and 7.

Now for the wiring. Condenser *E* is connected across the terminals of input coil *A*, with the rotary plates, with the ground terminal of the coil. The antenna binding post is connected with the tap on coil *A*.

Now wire the filament circuits of the three sockets, *I*, *J*, and *K*, with the rheostats *L* and *M* and the A-battery binding posts, as shown in the wiring diagram, Fig. 2. Next, connect a wire from the grid of socket *I* with the stator plates of condenser *E*, and from this same wire run a branch to one terminal of the neutralizing condenser *H*. The other side of condenser *H* connects with the tap on coil *C*.

The plate terminal of socket *I* next is connected with one end of coil *B*, and the other terminal of coil *B* is connected with the amplifier plus B binding post and the wire continued around to one terminal of jack *P*.

THE terminals of coil *C* now can be connected with the terminals of condenser *F*. Be sure that the rotary plates are connected with the wire that is continued to the filament circuit of socket *J*. The grid condenser *G* now can be connected between the stator plates of condenser *F* and the grid terminal of socket *J*. Make this connection just as short as possible. The grid condenser is supported by the wires leading from it.

One terminal of coil *D* is connected with the plate terminal of socket *J*, and the other goes to the *P* terminal on transformer *N*. The *B* terminal on transformer *N* is next connected with the detector *B* binding post. This completes the wiring, with the exception of the secondary circuit of the transformer *N* and the plate circuit of socket *K*.

The *G* terminal should be connected with the grid terminal of socket *K* and the *F* terminal with the battery side of rheostat *L*. The last wire is that which connects the plate terminal of socket *K* with the remaining terminal of jack *P*.

When the wiring has been completed and rechecked against Fig. 2, connect the antenna, the ground and the batteries. Insert tubes in the sockets, first making sure that the rheostats are on the "off" position. Now turn up the rheostats until the tubes are burning dimly. If squeals or whistles are obtained, adjust the neutralizing condenser until they disappear.

(Continued on page 150)

How to Do without Radio Batteries

Simple Ways to Run a Set from a Farm Lighting Plant

By Alexander Senauke, M.E.

THOUSANDS of American homes today are equipped with independent lighting plants that supply a ready source of power with which the radio receiving set can be connected so as to eliminate the use of special A and B batteries.

A number of different makes of farm lighting units are in use in various parts of the country, but all can be divided into two classes—those that use storage batteries and those that do not. The units that operate with storage batteries have been well standardized so far as voltage is concerned, so that the battery of practically every farm lighting unit develops either 32 volts or 110 volts.

If your home is equipped with a 32-volt system, you can dispense with all extra batteries for your radio set if your receiver uses only one tube. A multi-tube set, however, requires more than 32 volts, so that with such a set it still will be necessary to use one block of B battery to obtain the correct plate voltage for the amplifier tubes.

With the 110-volt system, the voltage will be found ample for all requirements.

Figure 1 shows one way to follow to hook up the receiving set to either the 32-volt system or the 110-volt system. No connection is necessary to the minus B binding post, because this post is connected inside the set with either the minus or plus A binding post and this connection is already made for you in the battery itself.

There is one objection to this way of obtaining the filament current that applies particularly to multi-tube sets. The extra drain on the first three cells, if the receiver is used constantly, eventually may exhaust these three cells, or the rest of the cells may have to be overcharged too often to keep them up to voltage.

Figure 2 illustrates another way of connecting up that employs a resistance unit to overcome this objection. It is also easier to connect up, since no special wire has to be run all the way from the battery to the receiving set.

The table at the bottom of this page gives the value of the fixed resistance that should be used with the hook-up shown in Fig. 2 to cut down the voltage for the filament circuit when from one to five .06-ampere or quarter-ampere storage-battery tubes are used on either 32 or 110 volts. If the battery is situated a considerable distance from the receiving set, the resistances specified for 32-volt circuits may have to be cut down somewhat, owing to the drop in voltage over the line.

There is one point that should be mentioned in connection with the circuit of Fig. 2. Do not turn off or remove one tube from the socket while the current is turned on, as this would throw an extra load on the other tubes and they might burn out.

STORAGE batteries form a source of power supply for radio work that is ideal because the current flow is perfectly even and steady and the voltage drop is so slight between full charge and normal discharge that it does not affect the adjustment of the filament or plate control. However, when the generator is running to charge the batteries of a farm lighting outfit, there usually is a slight hum, depending on the condition of the generator brushes and the capacity of the battery with relation to the charging rate of the generator. Most of the systems are automatic in operation so that the generator starts charging when the battery voltage drops, indicating that a charge is necessary.

If you are going to use a set employing several tubes that would amplify this hum enough to be troublesome, it will be worth while to have the service man from the company that supplied the outfit arrange a switch that will prevent the generator from starting when you are trying to receive. The switch should be placed handy to the radio receiver.

Since most farm lighting outfits are so adjusted that the generator starts long before the battery has reached the discharged condition, holding up the charge in this way for an hour or two will not cause any damage.

The diagrams shown here can be applied to all forms of home lighting outfits except those that use a 110-volt generator instead of storage batteries. In next month's issue such outfits will be covered in an article that will show you how to use the 110-volt lighting current from the street mains to run your radio set.

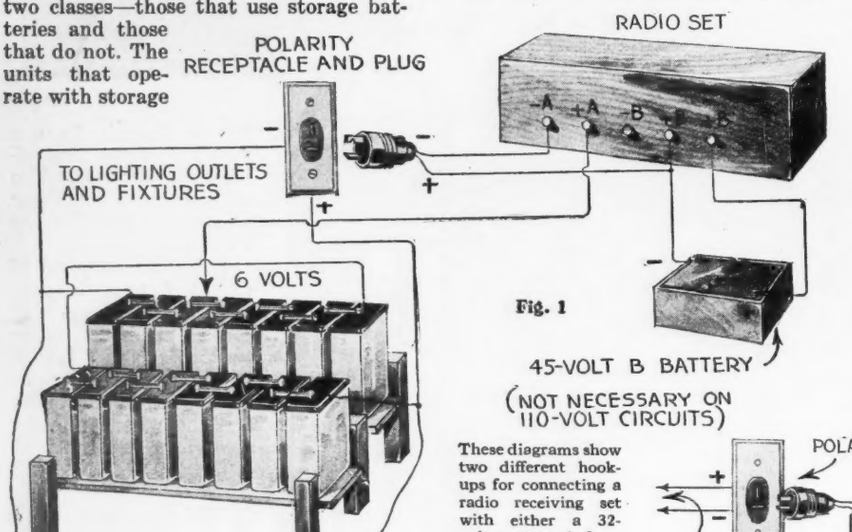


Fig. 1

These diagrams show two different hook-ups for connecting a radio receiving set with either a 32-volt or 110-volt farm lighting storage battery system. The one at the right uses a fixed resistance, the value of which can be determined by the table below

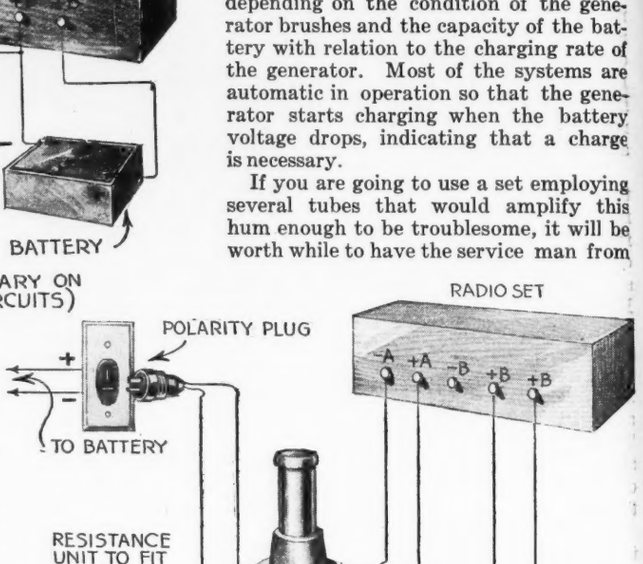


Fig. 2

What Fixed Resistance to Use

THE following table, prepared by Alexander Senauke, expert of the POPULAR SCIENCE INSTITUTE of STANDARDS, shows the value of the fixed resistance that should be used with the hook-up in Fig. 2, according to the number and kind of tubes employed in the receiver and the voltage used:

No. of tubes	.06-Ampere Tubes		Quarter-Ampere Tubes	
	32 volts	110 volts	32 volts	110 volts
1	450 ohms	1750 ohms	100 ohms	420 ohms
2	230 "	870 "	55 "	210 "
3	150 "	590 "	36 "	140 "
4	115 "	440 "	27 "	105 "
5	90 "	350 "	21 "	84 "

An Easy, New Way to Drill Panels

Useful Ideas that Will Simplify the Hard Jobs in Radio

By Robert E. Martin

DRILLING the panel is a job that many a new radio fan tackles with fear and trembling. He feels confident of success so far as the small holes are concerned—those of, say, three-sixteenths of an inch or less; but the big holes present quite a problem.

In the first place, big drills cost money, and in the second place the average fan usually does not own a drill brace that will hold drills larger than one-quarter of an inch. Yet there are a number of radio instruments that require holes larger than this in order to fit them to the panel.

I happened to be in a hardware store the other day when the proprietor was rearranging some of his stock. Among the pile of merchandise on the counter were some reamers. One long, thin box struck my eye. It was marked: "Taper—⅛ to ½ inch."

As I had gone into the store to buy some big drills to make the holes in a new panel, it occurred to me to see what that reamer would do in radio work, so I bought it at a cost of 80 cents—less than the cost of two sizes of the large drills.

In Fig. 1 is shown the reamer in operation, as well as the result of an experiment on a particularly tough and brittle piece of bakelite.

A row of holes was drilled with an ordinary one-eighth-inch twist drill and then the reamer was inserted in a bit brace and turned into the holes. It ate its way through as if the panel were just so much cheese—and quickly too. No chipped nor marred edges, and the holes were clean and smooth.

It is true that each hole left by the reamer has a slight taper to it, but not enough to make any difference for radio work.

With one twist drill and this standard sized reamer, you are equipped to fit to a radio panel any instrument that does not require a hole larger than one-half inch. Just try this way of "drilling" the next panel you make.

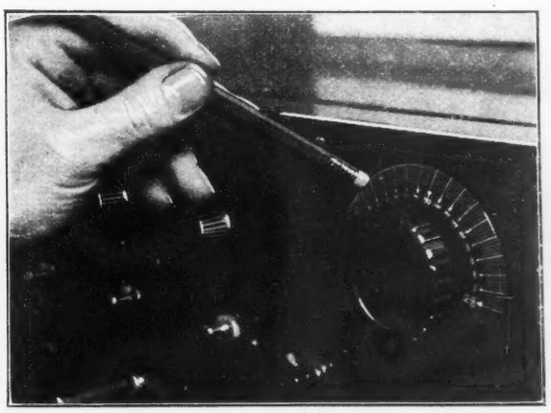


Fig. 2. An ordinary pencil eraser aids in close tuning. With the rubber pressed against the panel and the edge of the dial, the pencil is rotated, making minute changes in the setting

For Close Tuning

DO YOU find it difficult to make those close adjustments of the dials that bring in the distant stations with maximum loudness? Here is a little kink that will give you practically as good results as micrometer dials at a cost of five cents.

Use an ordinary lead pencil held as shown in Fig. 2, with the rubber pressed against the panel and the edge of the dial. When you rotate the pencil, the dial will turn slowly. In this way it is easily possible to make changes in the setting so small that you can hardly see the dial move.

This method is particularly valuable for use on receivers that are troubled with capacity effect. The pencil keeps your hand a considerable distance from the panel.

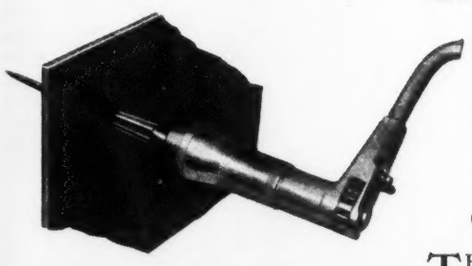


Fig. 1. How a standard taper reamer may be used to drill any size hole, from one-eighth to one-half inch, in your radio panel, as shown in the radio panel below

Charging B Batteries

THE usual way to charge storage B batteries that develop not more than 50 or 60 volts is to place a single chemical rectifier cell in series with the battery, an electric-light bulb to reduce the current to the proper value, and the 110-volt alternating current from the street mains.

The peak voltage on each side of the cycle of 110-volt alternating current is in the neighborhood of 155 volts, so that it ought to be possible to charge batteries up to at least 120 volts by this system. But practically, it cannot be done because of the losses in the rectifier, produced by the high voltage applied to the rectifier when the direction of current is opposite to that which charges the battery.

The charging system shown diagrammatically in Fig. 3, gets around this difficulty by the use of two rectifier cells so arranged that one side of the current wave charges one half of the battery, and when the current swings to the other direction, the second rectifier cell sends the current through the other section.

To charge the battery it is necessary only to clip the wires on the battery as shown and close the double-pole switch. Be careful to connect the lead and aluminum plates as they are in the drawing, for if you get them reversed, the battery will be charged in the wrong direction.

The rectifier cells should be of one-quart capacity and the aluminum plates should have an area exposed to the solution of not more than one square inch. The size of the lead plates can vary from two to several square inches.

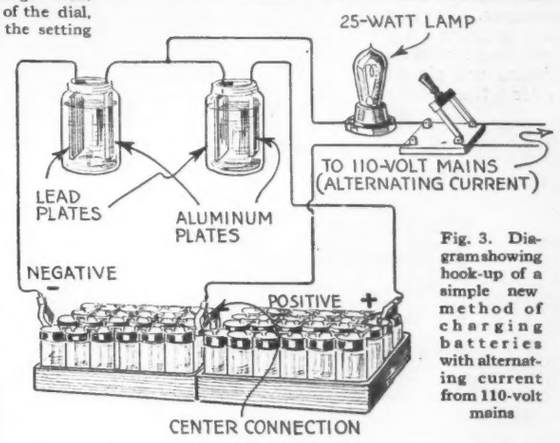
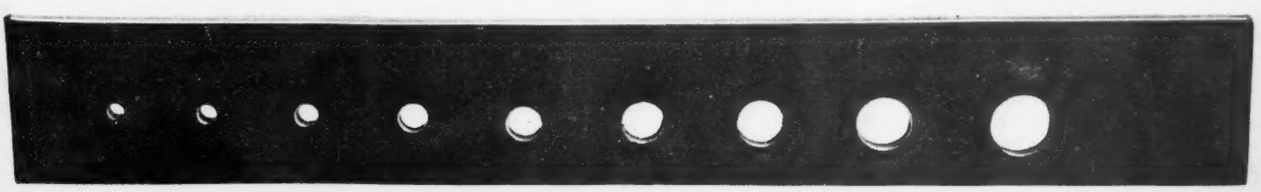


Fig. 3. Diagram showing hook-up of a simple new method of charging batteries with alternating current from 110-volt mains

The electric-light bulb should be the twenty-five-watt size.

The solution to be used in the rectifier cells is borax dissolved in pure water until you have a saturated solution.

When you have the rectifier completed, it is necessary to hook the three clips together and allow the electric bulb to burn for about half an hour. This will form the plates and you then can hook the clips on the battery terminals as shown and charge the battery.



Twenty-One Inventions

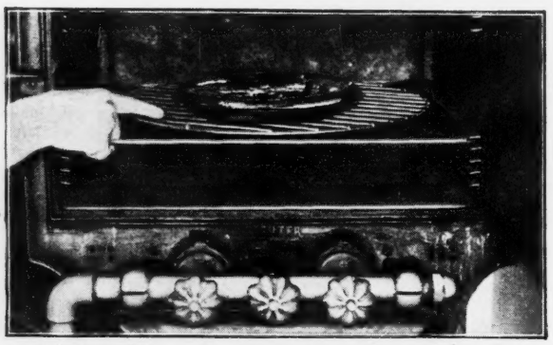
The Latest Household Suggestions in Pictures

A new portable electric ironing machine, controlled by hand levers, can be set out of the way easily when not in use

Troublesome cords are eliminated by new electric irons that are used with an electrically heated contact base

Turning steaks or roasts is simplified by this triple-jointed double-pronged cooking fork

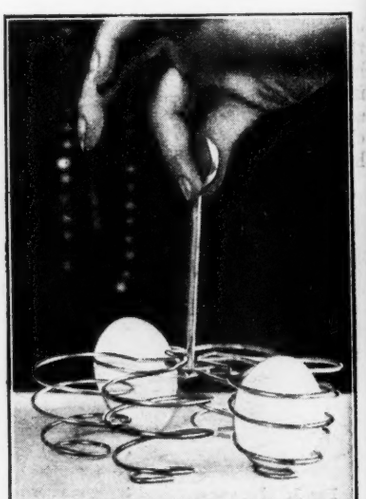
The teakettle below is also a plate-warmer. It has an opening through which plates are placed over the water



This revolving wire oven rack provides a convenient means of removing cooking food from the hot oven

A labor-saving floor-waxer with long handle. Wax is applied through a cheesecloth cover

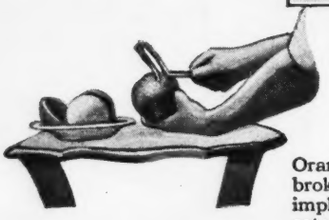
This handy four-in-one kitchen implement serves to open cans, chip ice, open milk bottles and remove metal caps from bottles



From one to six eggs can be boiled at once in this wire basket, which folds to fit smaller vessels

Placed over the gas flame, this circular cooker catches drippings, concentrates the heat, saves pans, and keeps the stove clean

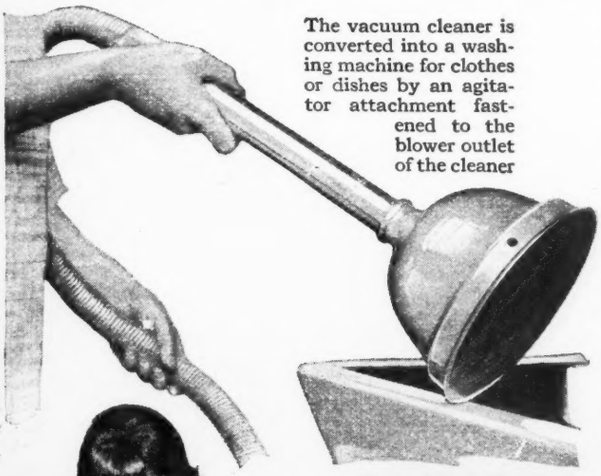
A trapdoor on the ashcan cover prevents dust from flying all over the cellar



Orange peel is removed in unbroken halves by a new curved implement that cleanly separates the peel from the fruit

to Save Your Wife Work

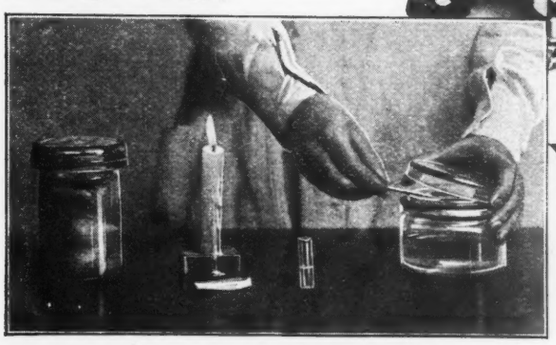
and How They Add to Every-Day Convenience



The vacuum cleaner is converted into a washing machine for clothes or dishes by an agitator attachment fastened to the blower outlet of the cleaner

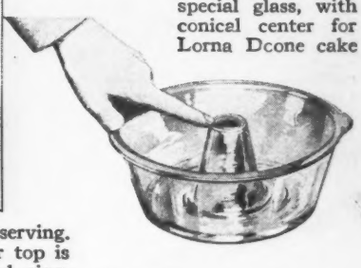
Here is a compact new washing machine with large capacity. A sealed air space between inside copper tub and outside covering holds the heat in. The machine has a swinging wringer attachment

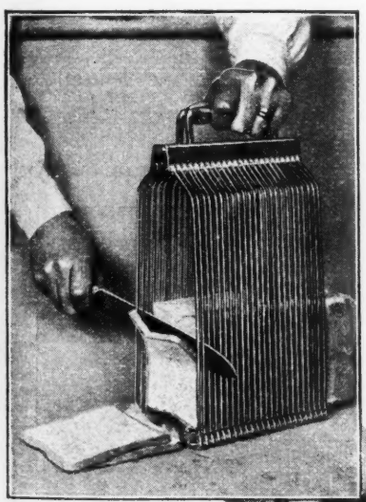
Two kinds of food can be cooked at once in this two-section frying-pan



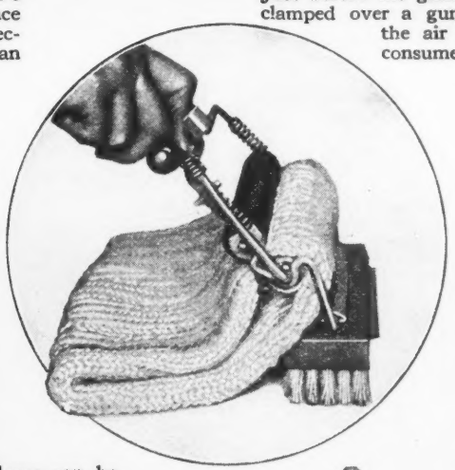
A new method of preserving. Just before the glass jar top is clamped over a gummed ring, the air beneath is consumed by flame

Below is a new baking-dish of special glass, with conical center for Lorna Doone cake

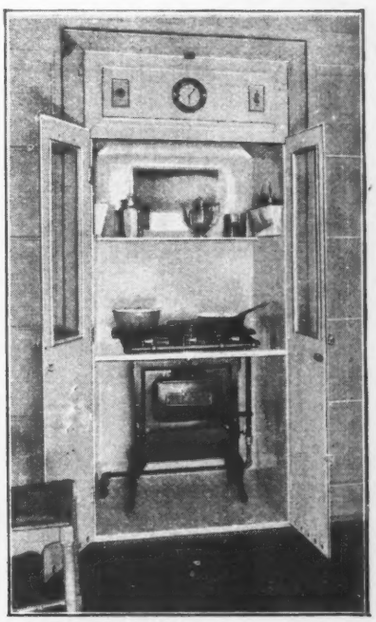




A wire cage for cutting bread into even slices for sandwiches. The knife is inserted between the wires

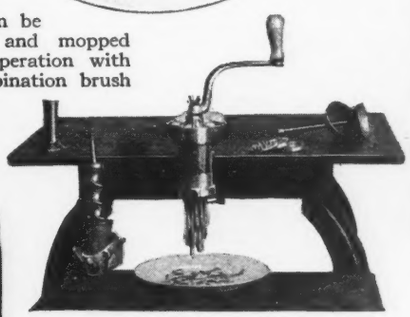


Floors can be scrubbed and mopped in one operation with this combination brush



To prevent offensive cooking odors, and to do away with the heat of cooking, this cabinet has been designed to inclose the stove. A special ventilator built above the stove carries away the odors

A highly concentrated new gas in crystalline form is contained in this new moth preventive



A remarkable grinder with attachments for stuffing sausages, pressing fruit, and grinding meat

Is Your Car in Trim for Winter?

An expert's practical hints on how to prepare it for freezing blasts, whether you drive it or store it

By George A. Luers

I AM going to tell you about two automobiles that I saw during the last year.

The first was a smart coupé of expensive make. I came upon it one exceptionally cold day on the main highway between Washington and New York. The hood was up and two men were peering in at the engine. One I recognized as a well-known Washington professional man. The other was the proprietor of a gasoline station situated about a mile from the place where the car was standing.

The car had run out of gas on the road, and its owner had walked to the filling station to replenish the supply. In the short time it had taken him to reach the station and to drive back with its owner, the engine had cooled down and frozen solid, bursting the cylinder block. This necessitated a long tow, extensive engine repairs, and loss of the use of the car for a couple of weeks.

All because the owner had failed to use alcohol or other anti-freeze mixture in his radiator, assuming that he was secure from danger because he kept the car in a heated garage at night!

THE other car I saw a few months later—on one of the first warm days of spring. It was in the garage of a friend of mine who lives in the suburbs of Washington. He uses the car, a medium-priced one of popular make, only for pleasure, and had, so he said, "put it up for the winter." That is to say, he had run it into his garage in the fall, opened the radiator petcock to drain the cooling system, and had gone out, locking the garage door behind him.

For four months he had not so much as looked at the car, and when he tried to take it out, it refused to run. He asked me to run over and see what the trouble was, and the things I found the matter with that car were plenty!

The storage battery was cracked. The fan belt was broken. The four tires were flattened and weakened from supporting the weight of the car. The exposed steel parts of the engine and electrical system were liberally coated with rust.

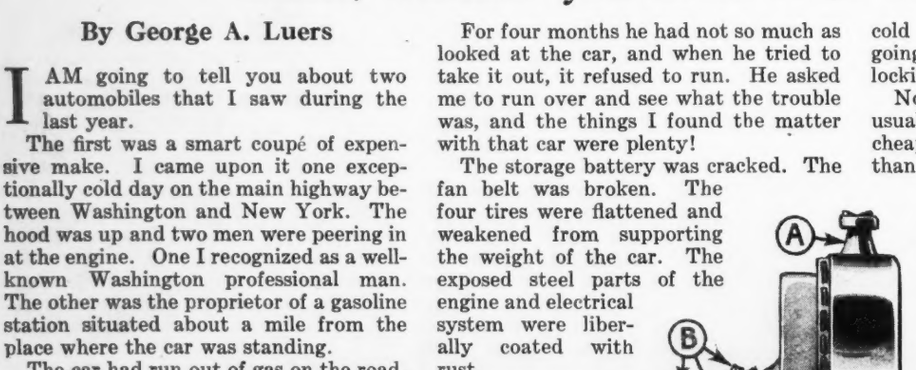
Now, these two cars supplied perfect illustrations of what *not* to do with your automobile in winter, whether you run it, or keep it in your garage.

To operate a car through the winter without preparing it for the ravages of the weather is almost as foolish as it would be to try to make yourself comfortable for the winter in a house without a heater. And to keep your car in the garage for several months without safeguarding it against its insidious enemies, cold and moisture, is quite as bad as going away on your vacation without locking your front door.

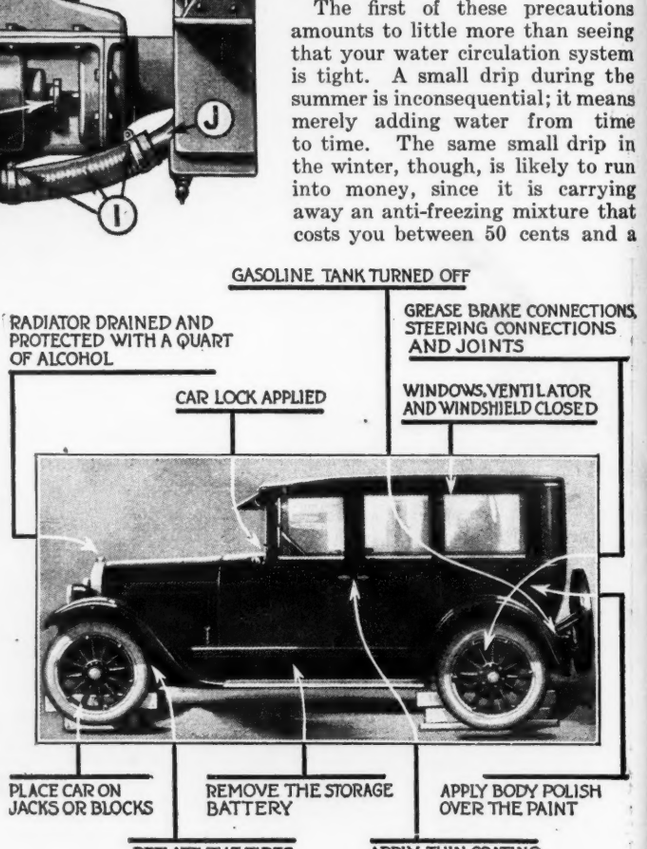
Now, strange as it may seem, it is usually better for your car, and it may be cheaper, to keep it in operation all winter than to lay it up. Outside of a slightly larger consumption of gasoline and the cost of alcohol or other anti-freeze compound, it is scarcely more expensive to run a car during the winter than during the summer, while it may be most expensive to lay a car up and have it meet the fate of the one I described above. Also, a car that is in daily use must receive a certain amount of care to be kept running efficiently, while the car that is locked up in a cold, sometimes snowbound, garage scarcely invites attention.

IF YOU intend to run your car through the winter, as most people do, you must do three simple things: Prepare the engine for anti-freeze compound, put in the anti-freeze compound, and renew the latter as it evaporates or is lost through leakage.

The first of these precautions amounts to little more than seeing that your water circulation system is tight. A small drip during the summer is inconsequential; it means merely adding water from time to time. The same small drip in the winter, though, is likely to run into money, since it is carrying away an anti-freezing mixture that costs you between 50 cents and a



This diagram shows important points to safeguard against leaks in preparing your engine for anti-freeze compound: *A*—Radiator. Clean by washing. Use sealing compound to repair slight leaks. *B*—Cylinder outlet hose. Renew if condition is doubtful. Tighten clamps every two to four weeks. *C*—Cylinder flange gaskets. Tighten and shellac. *D*—Cylinder head gasket. Tighten and shellac. *E*—Flange gasket. Tighten and shellac. *F*—Cylinder inlet hose. Renew if necessary. Tighten clamps every two to four weeks. *G*—Packing nuts. Tighten every two to four weeks. *H*—Flange gasket. Tighten and shellac. *I*—Pump hose. Renew if necessary. Tighten clamps every two to four weeks. *J*—Radiator outlet. Wash clean and repair large or small leaks with a reliable sealing compound


GASOLINE TANK TURNED OFF
RADIATOR DRAINED AND PROTECTED WITH A QUART OF ALCOHOL
GREASE BRAKE CONNECTIONS, STEERING CONNECTIONS AND JOINTS
CAR LOCK APPLIED
WINDOWS, VENTILATOR AND WINDSHIELD CLOSED
PLACE CAR ON JACKS OR BLOCKS
REMOVE THE STORAGE BATTERY
APPLY BODY POLISH OVER THE PAINT
DEFLATE THE TIRES
APPLY THIN COATING OF VASELINE OVER THE NICKEL TRIMMINGS

If you are storing your car for the winter, the precautions indicated above will save you unnecessary trouble and expense when you bring it out in the spring

dollar a gallon. Reference to the accompanying diagram will show you where to look for leaks and how to repair them.

Rubber hose connections are the most frequent cause of leaks, and it is usually well to renew these before filling with anti-freeze if they are old or their condition is doubtful. Renewal of the pump packing is another job that should be done before the anti-freeze is placed in the radiator. It is also well to tighten the hose clamps and pump gland every two weeks or so during the winter, since these parts may become loosened in driving.

Small leaks in the radiator can be repaired with a radiator leak-sealing compound. This should be done a couple of weeks before the anti-freeze is used, to give the cement a chance to set and harden. Sometimes the solvent action of the anti-freeze will cause unsuspected leaks to appear. A pound of washing soda dissolved and poured in the radiator will wash the dirt and slime from the cooling system and disclose the location of such leaks in time to repair them.

In addition to the various commercial anti-freezing solutions, denatured alcohol, a mixture of half denatured alcohol and half glycerine, and calcium chloride, mixed with the water in the cooling system in correct proportions, supply effective means of preventing a car from freezing.

THE following tables show the proportions in which these mixtures should be used for various degrees of cold. The quantities given are for Ford cars, the radiator capacity of which is 2½ gallons. The same proportions should be maintained, of course, for larger cars:

DENATURED ALCOHOL

Percentage of Alcohol	*Quantity*	*Freezing Point*
10	1 quart	25° F.
20	2 quarts	15° F.
25	2½ quarts	5° F.
30	3 quarts	5° F. below
40	4 quarts	20° F. below
50	5 quarts	35° F. below

HALF GLYCERINE AND HALF DENATURED ALCOHOL

Percentage of Mixture	*Quantity*	*Freezing Point*
10	1 quart	25° F.
20	2 quarts	15° F.
25	2½ quarts	5° F.
30	3 quarts	5° F. below

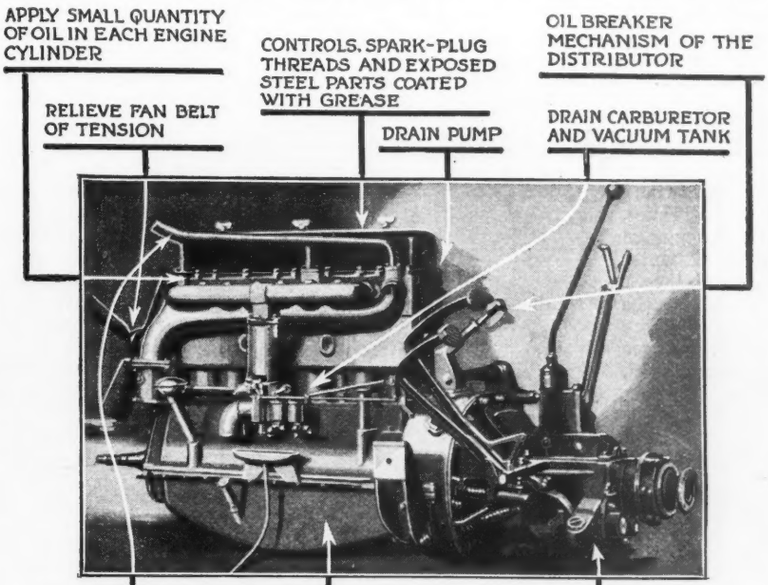
CALCIUM CHLORIDE

Pounds of Calcium Chloride	*Freezing Point*
5	18° F.
8	0° F.
10	15° F. below

Neutralize by the addition of ammonia to the point where the litmus paper fails to turn its color.

Your car will lose anti-freeze mixture in the winter through leakage, evaporation, or both. If you use alcohol, or alcohol compounds, remember that these evaporate faster than the water with which they are mixed, and that you must make up for this difference when you replenish the supply. In other words, use a slightly stronger solution than you used when filling the radiator for the first time.

Calcium chloride does not evaporate, so that if you use this solution, unless your car leaks considerably, it will be necessary for you to replenish the liquid in the cooling system with water only.


APPLY SMALL QUANTITY OF OIL IN EACH ENGINE CYLINDER
CONTROLS, SPARK-PLUG THREADS AND EXPOSED STEEL PARTS COATED WITH GREASE
OIL BREAKER MECHANISM OF THE DISTRIBUTOR
RELIEVE FAN BELT OF TENSION
DRAIN PUMP
DRAIN CARBURETOR AND VACUUM TANK
SHELLAC RADIATOR-HOSE CONNECTIONS
DRAIN CRANKCASE AND REFILL
COAT STARTING MOTOR AND GENERATOR WITH CUP GREASE

Parts of the engine and electrical units that require attention before storing your car for the winter months. The simple precautions to be taken in each case are indicated

If your car is in good mechanical condition, the foregoing is really all you need to do to enjoy it through the winter. However, you may live in a region where heavy snows and poor roads make winter motoring impossible. That means storage, and storage, unless accomplished intelligently, means trouble.

The first thing to do with a car that is to be laid up for the winter is to drain out the old engine oil and refill with new. This prevents heavy particles settling and clogging the oil ducts. Next, drop a tablespoonful of cylinder oil in the head of each cylinder and crank the engine vigorously to spread the oil on pistons, rings, and cylinder walls to prevent rust.

Drain the radiator and pump, and pour a quart of denatured alcohol into the radiator after closing the petcocks lest water be retained by clogged tubes or pipes.

COAT all exposed metal parts of the engine with cup grease. Relieve the tension of the fan belt, and coat the radiator hose connections lightly with shellac to prevent decay of the rubber.

The various movable parts of the chassis—brake rods, connections, steering-gear parts and the like—should be protected from rust with cup grease. It is not necessary to drain the gasoline tank, but the fuel line petcock should be closed, and the vacuum tank and carburetor should be drained to avoid leakage and freezing if water has collected. The screwed hubs and retaining nuts of disk wheels or demountable wheels should be covered with a film of heavy oil.

The axles should be raised and the car set on jacks, paving bricks, wood blocks, or other substantial supports to bring the tires clear of the floor, and the tubes should be partly deflated to relieve the casings of strain. If the garage is damp, it is well to coat the juncture of tire and rim with shellac to avoid the possibility of the rim's rusting.

The electrical system demands especial care. Generator and starting motor should be protected from dampness with cup grease. The storage battery should be removed and should be charged once a month. This is important, for a discharged battery will freeze, and even a fully charged battery will discharge through internal leakage when not in use. The distributor head should be lifted and the breaker mechanism oiled to prevent rusting. The wiring, however, requires no special protection.

If yours is a closed car, close it up tight during storage to protect the upholstery from dust, dampness and vermin. If it is an open car, put up the top and button all curtains in place. This will prevent top and curtains from cracking, wrinkling, or rotting.

All nickeled parts should be smeared lightly with vaseline to prevent tarnish, while a liberal coating of body polish applied without rubbing down will protect the paint against sweating and moisture.

Winter Driving Hints

1. Be sure that the cooling system of your car is tight against leaks, and filled with the correct anti-freeze solution.
2. See that the carburetor is adjusted to a "rich" mixture.
3. Before starting in cold weather, always push out the clutch pedal. This will relieve the drag of the transmission on the starter.
4. The instant the engine starts, open the choke partway, and as soon as possible open it fully.
5. Let the engine warm up before trying to drive fast.
6. See that you always have an adequate supply of the correct grade of oil in the crankcase.

Kinks for the Home Garage

How to Save Your Time in Looking After a Car

GARAGES are normally narrow and any special equipment placed along the sides cuts down still more the limited space. After fouling his bench with the front wheel hub and tearing down an electric conduit with the opposite wheel, one car-owner made a wheel trough or runway at one side by bolting down "two by fours" as indicated in Fig. 1.

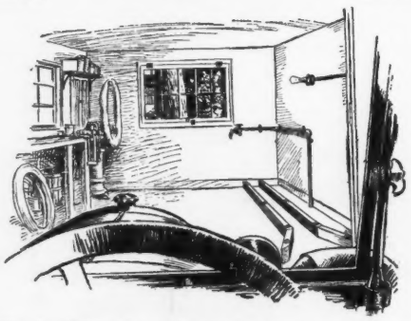


Fig. 1. Runway guides car into narrow garage

JOHNSON, one of my neighbors, who had done an extra good job of washing up his car in the garage one afternoon recently, drove into the garage as usual that evening and, in spite of his brakes, smashed both headlights on the garage workbench. The combination of water and oil was too much for the brakes.

Reasoning that rubber would be the best thing to clear the smooth concrete of water, Johnson made a simple squeegee from an old inner tube, strips of iron, a pipe nipple, two nuts and a broom handle, as shown in Fig. 2.

An oil pan was made by bending a sheet of roofing tin into a tray as indicated, the corners being made without rivets or cutting.

Now, after washing up, Johnson quickly sweeps the water off the floor. The pan is filled with sawdust and placed under the engine to catch the dripping oil. When draining the crankcase, transmission, or differential, the pan is used as a catch basin.

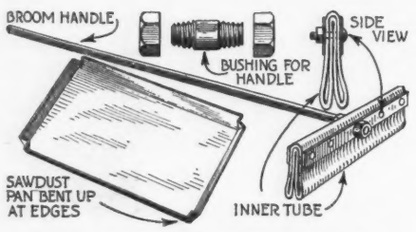


Fig. 2. Garage floor squeegee and oil pan

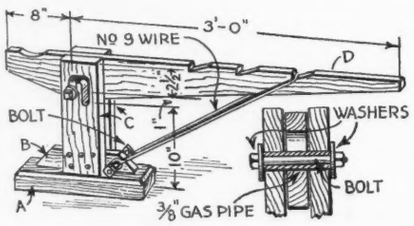


Fig. 3. Quick-acting jack for light cars

Fig. 4. Patching a top

These simple expedients result in the floor's remaining clean all the time. Johnson also saves himself the task of wiping up the grease.—G. A. L.

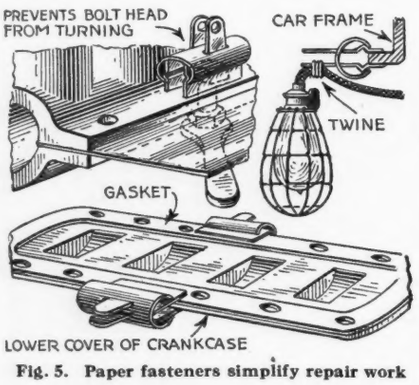


Fig. 5. Paper fasteners simplify repair work

MANY tops of closed cars are snagged by overhanging branches of trees and holes 2 or 3 in. long are torn. The repairman would prefer to replace the entire top section, at considerable cost, but the owner himself can make an inexpensive and quick repair through the use of a cementless or "cold" patch (Fig. 4).

Clean the rubberized fabric with gasoline around the broken area and apply a patch long enough to overlap the ends of the tear. This should be applied as on a tube, and the patch is dipped in gasoline before placing over the break. It is advisable, however, to place a weight, such as a flat-iron, over the patch for several hours.

EVERY car-owner has individual methods of simplifying and expediting repairs. A striking example of this is the case of a motorist who uses ordinary spring paper fasteners in many ways, three of which are illustrated in Fig. 5.

Used as a bolt holder, the fastener makes possible the insertion of bolts single handed in difficult places, as on the flanges of engine bases, where the worker cannot easily reach the bolt head and nut at the same time. In placing gaskets under crankcase cover plates, it is difficult to aline the gasket with the bolt holes. Fasteners are placed on opposite sides of the cover to hold the cork or felt gasket in line, and it will stay in position while the work of inserting the bolts is going on.

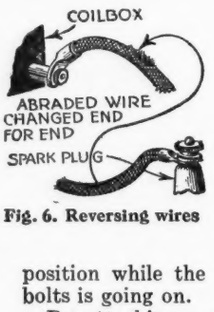


Fig. 6. Reversing wires

By attaching a spring fastener to the lamp cord of the trouble light close to the lamp, it is possible to snap the lamp quickly to any part of the chassis adjacent to the work.

THE light, quick-acting jack illustrated in Fig. 3 is a great convenience in the home garage. The base, *A*, is 2 by 4 by 12 in. *B*, which is screwed or nailed securely to it, is the same thickness as the lever, *D*. There are two pieces, *C*, fully 1 in. thick, screwed to either side of *B* and slotted as indicated. The slots permit a quick, easy adjustment to either the front or the rear axle of a Ford or similar light car. *D* should be of ash or other hard, tough wood.

An ordinary bolt will do for the pivot, but a ⅜-in. gas-pipe, cut just long enough to go through the uprights and lever and held in place by a light bolt and washers, is better because it affords a larger bearing surface and reduces friction.

The fastening loop, of No. 9 wire, has an eye at each end and is held by a bolt through *B*.—HOWARD E. GOOD, Waterville, Ohio.

A Wealth of Mechanical Articles in This Issue

WHETHER you are an amateur or a professional mechanic, a beginner or an expert, you will find many articles of absorbing interest in the following pages—things to build, household utilities, ways to keep your home shipshape, and better methods for the shop.

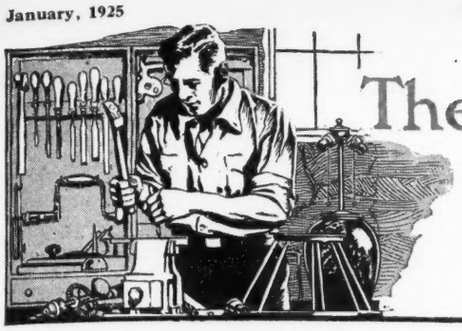
The Home Workshop (pages 89 to 129) this month has **42** articles with **70** illustrations. **The Shipshape Home Section (pages 122 and 123)** contains three columns of useful household ideas.

The Better Shop Methods Department (page 94 and pages 130 to 140) has many labor-saving hints for mechanics packed into its 15 articles.

THE electrical difficulties to which a car is subject often are due in part to short circuits and grounds that exist where the wires come in contact with parts of the engine frame or body. Many manufacturers advise that the car be rewired after a period of service to safeguard the electrical system, but the multiplicity of wires makes the rewiring a time-consuming job.

To eliminate most of this work, one owner of a completely equipped car simply reverses the wires wherever the installation permits. The wire is removed, turned end for end, and reconnected. Any part that is abraded, unduly flexed or weak, is protected by the shifting.

Another economical procedure is to reverse the wires from the coils to the timer on light popular cars.



The Home Workshop

Arthur Wakeling, Editor

How You Can Build a Fine Table

Construction Simplified for the Amateur Craftsmen

FOR the home worker who wishes to build a piece of furniture that is a little finer than anything ordinarily undertaken by amateurs, the accompanying details of a Sheraton table have been prepared.

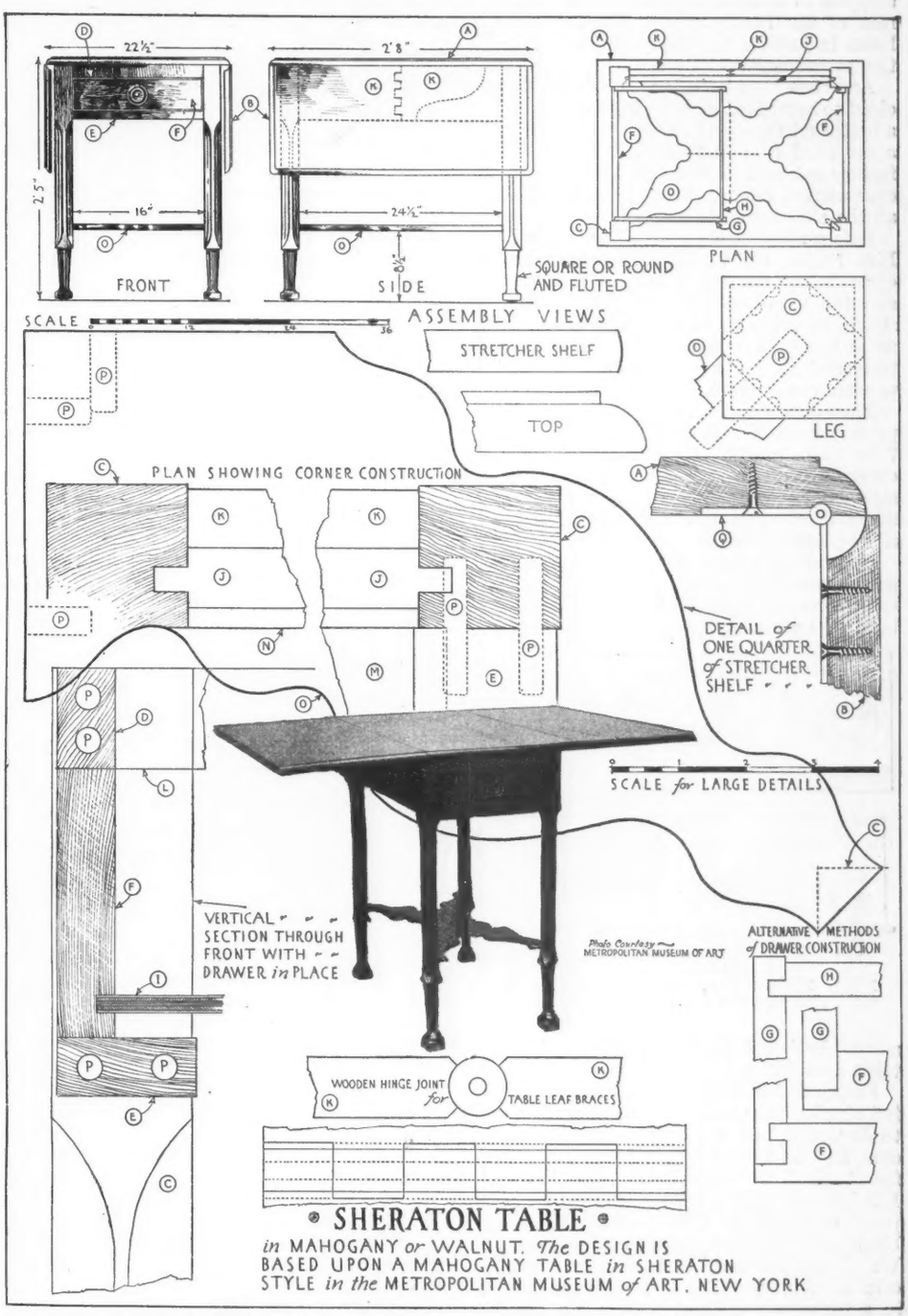
The table is one to grace any room. If carefully constructed and well finished in either mahogany or walnut, it will grow richer and more beautiful with age. It is exactly the type of furniture that becomes a prized heirloom. And the very fact that it is put together painstakingly by hand and is the product of the loving labor of many evenings at cellar or attic workbench adds to its intrinsic utility and value.

The design is based upon a mahogany table in Sheraton style in the Metropolitan Museum of Art. George F. Kaercher, the furniture-factory superintendent who prepared the working details, has made no attempt to follow slavishly the original. Using the museum piece simply to suggest the style, he has adapted the design to the requirements of home construction, simplifying it where possible.

In size the table is one to commend itself for many purposes, especially when space is at a premium, as in a small room or apartment. The top is 22½ in. by 2 ft. 8 in.; with both leaves extended, it is 2 ft. 8 in. by 4 ft. ½ in. The height is 2 ft. 5 in. There are two roomy drawers, one in each end.

There is nothing particularly difficult about the construction. Any woodworker with reasonable experience in building simple furniture, such as most boys acquire nowadays in their manual-training classes, will have no trouble in understanding the drawings or performing the individual tool operations. Success depends, however, upon great accuracy in laying out the stock and fitting the joints.

(*Continued on page 124*)



End, side, and plan views of the table, and larger details of the corner construction, drawers, legs, top, leaves, braces, and ornamental stretcher shelf. The parts are lettered to correspond with the bill of materials, which should be studied in connection with the drawings. Any dimensions may be found by using the graphic scales

Dressing Up Your Radio Receiver

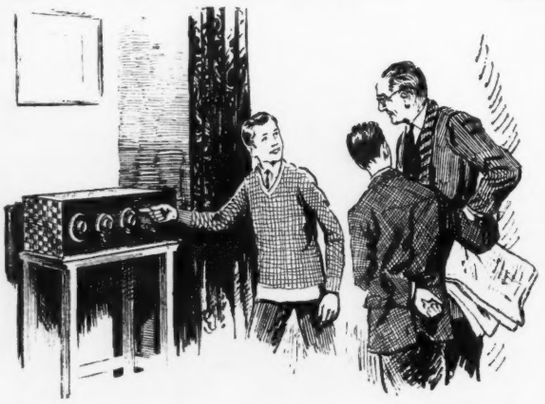
Secrets of "Style" in Constructing a Good-Looking Set

By W. R. Clendinning
Designer of Radio Apparatus

DAD dropped in on us one night and became thoroughly interested in something that was going on at our local station. The look in his eyes when Jim switched over to Kansas City, just to see it he could get them, told us a story we had never before realized.

"What selfish idiots we have been," said Jim to me later. "Here we have been doing all sorts of tricks with our sets and never stopped to think that perhaps the rest of the family might like to listen in just for the enjoyment of the programs."

And then the idea came. We decided to build Dad a set for himself; a better set than we had ever built; a set good enough to look like a factory set and to work as no set ever worked before. So we built it, with all the skill we could muster.



Before we started to make it, we asked Mrs. Smith, our next-door neighbor, to come in one day when Mother was out and tell us where she thought the set should be placed, and what sort of wood finish it should have to match our furniture, and similar questions that only a woman can answer.

Then Jim, who used to work for a carpenter, built a real cabinet, to take a 7 by 21 in. panel. He made it of oak, carved with a pretty checkerboard design. Then he stained and waxed it with much elbow grease, and put on fancy silver-plated hinges and catches.

I was all for going down and buying the parts immediately, but Jim said, "No, let's figure out what color dials will look best, and what sort of panel, jacks, and so on. Let's get the right trimmings if it takes a week."

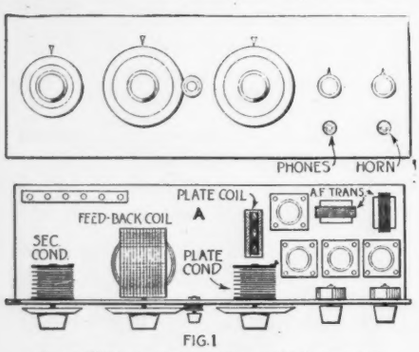


Fig. 1. The average amateur would consider this a good layout, but it has several defects

I suggested that, as the radio stores are full of splendidly designed sets, all we had to do was to find one with a cabinet like ours, and see what trimmings it had. We found what we were looking for in a Mission oak cabinet. It had a grained panel engraved in white, with lustrous black dials and nickel-plated trimmings. We almost lost our heart to some other color combinations, for there was one set in a mahogany cabinet with a lustrous black polished panel and dials, highly polished jacks and clear white engraving —a jewel among sets—and another set in an ornamented green leatherette case with an imitation mahogany panel engraved in gold, dials to match, and gold-plated jacks and screws.

Materials that Insure a Professional Finish

PANEL—Standard, of guaranteed quality. Dials of same material and finished to match or to contrast artistically.

Apparatus—Parts to match in appearance. All exposed metal to be nickel, silver, or gold plated.

Wiring—Silk-covered magnet wire, braided copper flexible leads, and tinned or gold-plated copper bus bar for connections. Bends to be neat and all wires as short as possible. Use only genuine spaghetti. Insert key socket bushings where wires pass through cabinet.

Cabinet—Genuine mahogany, walnut, or oak, with furniture finish.

Avoid—Fiber, pasteboard, cheap rubber, paper, iron, wood (except for cabinet and baseboard), compositions known as "mud," friction contacts (except where absolutely essential), cheap spaghetti, apparatus not of standard make and fully guaranteed.

Knowing what sort of dials and panel trimmings we had to buy, the rest was easy. Of course, we were particular to get the best instruments both in efficiency and appearance. We got coils wound with green silk covered wire, condensers designed for low loss, with verniers, and real spaghetti, soldering lugs, and tees.

And then we planned the layout. We figured things out about this way:

First, the set should come pretty close to filling the cabinet we put it in. And it should fill it all over, not in spots.

Second, the front panel should be "balanced"—a dial here, another there on a straight line with the first and the same distance from the edge of the panel; a little engraving to fill up a bare spot; and not too much "weight" on either side of the panel.

Third, the instruments should be arranged with fair uniformity in the rear of the panel and in such positions that the wiring would be short and direct.

Fourth, it should look as neat inside as out.

We took our blank panel and laid out on it the dials, jacks, nuts, and so on, in various positions. Our first trial was of a layout as shown in Fig. 1. Then we found:

First, the grid wire would be 9 in. long from the secondary condenser to the grid of the radio-frequency tube.

Second, the plate connection would be parallel to the grid wire.

Third, the tube sockets and transformers were jammed together at the right end of panel and yet there was a lot of unused space at point marked A.

To make a long story short, we juggled with front panel and rear panel layouts for a couple of days before we drilled a hole in the panel. The last layout is shown in Fig. 2, and has the following advantages:

On the front panel, the 3-in. dial with the vernier, that is so necessary with the special feed-back coil used with our hook-up, and the two 4-in. dials on each side of it "balance" nicely. Placing the rheostats above the center line of the panel and the jacks in a straight line directly below them, gives more weight to the right side and eliminates the bare space usually found above rheostats in amateur sets.

The layout of instruments behind the panel is more satisfactory, for the space is very evenly filled. The grid and plate leads are well separated, and the plate and coupler coil are entirely out of inductive relation, as they should be.

The aerial and ground binding posts are on a separate block at extreme left of panel, thus producing short leads to the 4-turn primary. The grid lead is 3 in. long from the feed-back coil secondary to the grid. The plate wiring, started at the plate of the radio-frequency tube, runs

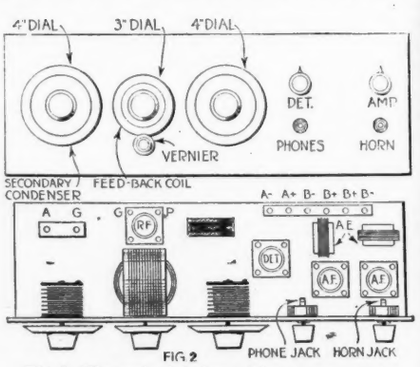


Fig. 2. The revised design with apparatus and panel conforming to professional standards

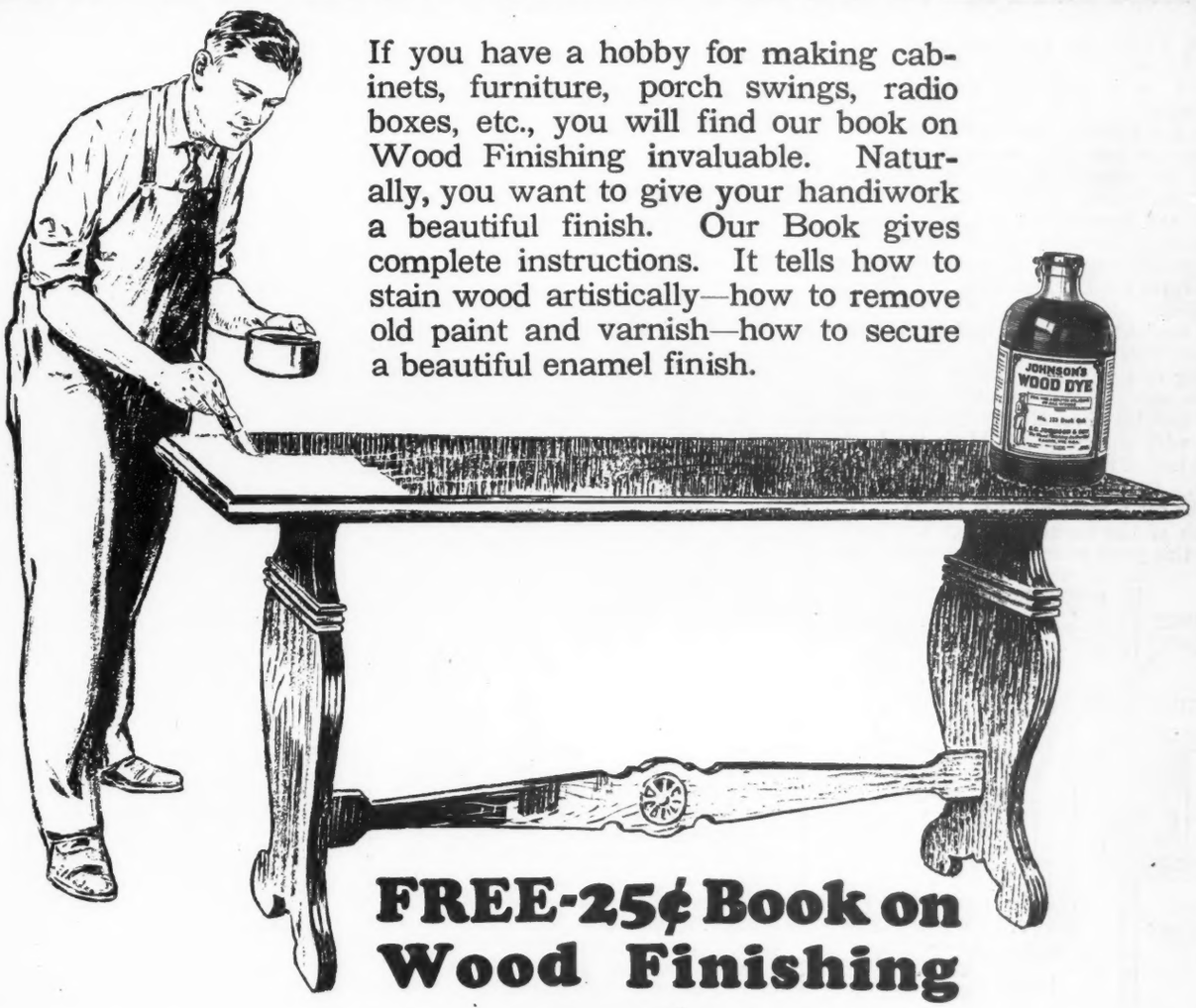
4 in. to one side of the feed-back coil rotor, from the other side of the rotor to one side of the plate condenser (which is shunted with the plate coil) and from the other side of this shunt to the detector B-battery binding post, and to the grid condenser of the second or detector tube.

The layout finally being approved, we took our panel to a local engraver and told him to put his best man on the job. He also drilled it for us without burrs.

Then came the wiring. This was play. Wherever a wire joined a binding post we used solder lugs and spring washers,

(*Continued on page 124*)

How to Finish Home-Made Furniture



If you have a hobby for making cabinets, furniture, porch swings, radio boxes, etc., you will find our book on Wood Finishing invaluable. Naturally, you want to give your handiwork a beautiful finish. Our Book gives complete instructions. It tells how to stain wood artistically—how to remove old paint and varnish—how to secure a beautiful enamel finish.

FREE-25¢ Book on Wood Finishing

This book gives complete instructions for finishing all wood—hard or soft—old or new. Explains just what materials to use and how to apply them. This book is the work of experts—illustrated in color. Contains a hundred wood finishing hints.

It tells how inexpensive soft woods may be finished so they are as beautiful and artistic as hard wood. Includes color charts — gives covering capacities, etc. Contains practical suggestions on making your home artistic, cheery and inviting.

JOHNSON'S WOOD DYE

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123—Dark Oak	*131—Walnut*
129—Dark Mahogany	*126—Light Oak*
127—Brown Mahogany	*124—Golden Oak*

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Please send me free your Instruction Book on Home Beautifying and Wood Finishing. I enclose 10c to cover postage and wrapping.

MY DEALER IS.....

My Name.....

Address .....

City and State.....

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 31.

Making and Setting a Door Frame

By Edwin M. Love

WHEN the home mechanic cuts a new doorway in a partition, he is confronted with the problem of setting a door frame in the opening; and if he is not merely shifting the location of a door, he has also to make the frame.

If the opening is trimmed properly for 1-in. jambs, it will be 2½ in. wider than the door (allowing 1½ in. for the finished thickness of the jambs and 1 in. for plumbing) and 2 in. higher, allowing ¾ in. for the head jamb and 1¼ in. for leveling.

A straight-edge 6 ft. 4 in. long is necessary. This may be made from an old casing or any suitable board, with both edges straight and parallel. With this test the plumbness of the trimming studs, and with shingle points block the hinge stud behind the hinge positions to plumbness. From a board the width of the jambs cut a piece equal in length to the width of the frame inside at the head. Use this piece to serve as a spreader for

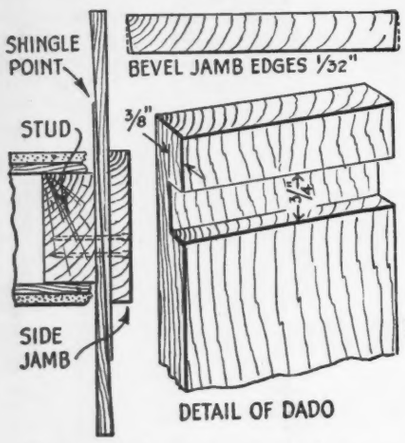


Fig. 3. Shingle points used as wedges, a dado, and properly beveled jamb edges

the lower ends of the side jambs and to aid in squaring the opening.

Stand the frame in the opening, and, holding the level on the edge of the hinge jamb, plumb it with the wall and tack the top and bottom with 8d. finishing nails. Level the head, and cut off the bottom end of the longer side jamb. If the side jambs are sprung edgewise, the straight-edge and level must be used to insure the jamb's being plumb.

Fig. 1 (at left): Plumbing the hinge jamb of a door frame with a straight-edge and a level

Fig. 2 (below): Cutting off the end of the shingle points or wedges used to block the door jamb out from the stud behind

Drive shingle points between the stud and jamb in one or two additional places, as shown in Fig. 1, until the jamb is straight, and nail solidly to the studding through the portion that will later be covered by the door-stop.

Proceed in the same manner with the lock jamb, being careful to block where the lock keeper is to be fastened. If the wall is so much out of plumb that it is inadvisable to set the frame plumb edgewise, be careful to keep one jamb as much out of plumb as the other, or the door will appear to be twisted when shut.

Wedge the bottom of the jambs tightly against the ends of the spreader, nail solidly, and remove the spreader. Block the top jamb and cut off the projecting points of the shingles with a saw, as shown in Fig. 2. Breaking off these projections with the hammer is doubtful economy of time, since the jamb is likely to be knocked out of true.

To make a door jamb, cut the stock for the side jambs 3 in. longer than the door. Clean up the face side and straighten one edge, beveling it toward the back, as illustrated by Fig. 3, so as to insure a tight joint between it and the casing. Gage the stock in width about 3/32 in. wider than the thickness of the partition, rip to width, and bevel the other edge as well.

Leaving 1 in. of stock above the head jamb, dado for the head jamb ⅜ in. deep and just wide enough for the end of the head to fit in snugly. A good method of making the side cuts is illustrated in Fig. 4. Tack a short straight-edge across the jamb as a guide for the saw (cutting in the waste wood, of course) and hold another strip lightly against the saw. This insures a good, clean edge. Chip out the waste wood roughly with a chisel and finish with a light cut.

Assemble the parts by nailing into the ends of the heads with four 6d. box or finishing nails, and gage a pencil line around both edges a trifle more than ¼ in. from the face to guide in placing the edge of the casing.

To set a new frame, determine the height of the head jamb by marking on

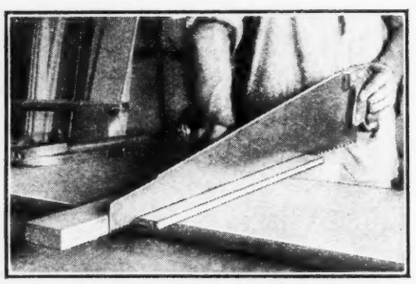


Fig. 4. Using two strips of wood to guide an accurate saw in cutting a dado in a door jamb

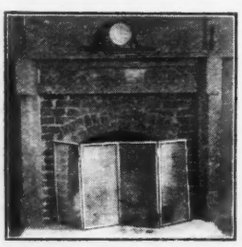
the wall. Stand the jamb in the opening, and scribe the bottom ends to the floor, being careful to set the scribers for the exact amount to be cut off. This fits the ends neatly to the floor.

ARCHED openings will be the subject of the next article in Mr. Love's instructive series.

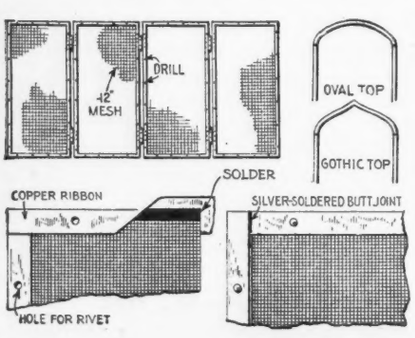
A Folding Screen for Your Open Fireplace

By E. E. Scott

A FIRE screen is a necessary adjunct to every home fireplace. Because of the high cost of real brass screens, however, many otherwise artistic chimney corners are made commonplace by the presence of a cheap black spark arrester designed for utility but not for beauty. The cheapest solid brass firescreens cost at least $2 a square foot and it takes a minimum of 8 sq. ft. for a small fireplace, that is, one with an opening 26 by 30 in. Sufficient material to make a four-section screen of this size can be bought for the small sum of $3.50.



The completed brass screen, which cost only $3.50 for materials, is shown at the left



Details of the screen and suggestions for ornamental tops shown at the right

Each section of the screen illustrated is 1 by 2 ft. The frames are made of bar stock brass ⅛ by ½ in., covered with 12-by-12 brass mesh, that is, mesh about as fine as fly screen.

To make the screen, obtain 24 ft. of bar brass from a hardware store or mill supply house and saw it into eight 24-in. lengths and eight 11-in. lengths. The short pieces are "butted" against the ends of the long strips to form a hollow rectangle and are brazed together.

(*Continued on page 118*)

FARAWAY GETS STATIONS FAR AND NEAR—LOUD AND CLEAR

Radio Fans tell of FARAWAY'S Amazing Long-Distance Performance

You, too, can own a Faraway with our unique MONEY-SAVING plan

"I CANNOT imagine how you can manufacture these Faraway sets and sell them at your retail prices," writes M. N. Jefferson of Salt Lake City, Utah. Mr. Adamson of Brampton, N. D., says: "We're all 'crazy' about the Faraway sets and I sell them as fast as I order them."

Almost every mail brings some enthusiastic report from a Faraway user. They do not realize that their successful experiences with Faraway are being duplicated night after night by thousands of Faraway set owners all over the country.

"The Faraway is the sweetest and clearest set I've ever listened to—no tube howls—no distortion—it's easily tuned and brings in fine volume. I have 143 stations logged so far and get new ones continually," writes J. D Shoptaugh of Bellevue, Ky.

Operates with Dry Cells or Storage Battery

Faraway sets are easily tuned, extremely simple to operate and always dependable. They operate with either Dry Cells or Storage Batteries. The latest improved type of set construction used only on high priced sets is employed.

SATISFACTION GUARANTEED OR MONEY REFUNDED

We guarantee all the things our users claim—namely—clear, sweet tone—fine volume—unusual long distance reception—can be logged—no tube howls, distortion or radiation. For beauty and fine workmanship Faraway sets set a new standard in radio receivers selling under $100—and you'll agree with us when you see it. For Faraway Cabinets are ornamental and massive—beautifully done in mahogany. The panel is finished in dull platinum with all calibrations finely etched in black.

So why pay more? You'll wonder like Mr. Johnson how we sell Faraways at these low prices. **Our unique selling** plan is the answer. Don't buy your radio set until you see the Faraway. We have a big surprise for everyone who writes for our literature and money-saving proposition. Mail the coupon today.

Dealers—Agents

Our Faraway proposition offers tremendous possibilities for you. Write quickly for plan and territory.

Ⓢ

THE FARAWAY RADIO COMPANY

653 W. Third Street **Cincinnati, Ohio**

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What they say:

"Crazy" about Faraway

My customers are just crazy about Faraway sets and I sell them as fast as I order them. We readily pick up Boston, Dallas, Frisco, Pittsburgh and many other stations.

R. J. ADAMSON, Brampton, N. D.

One Sells Another

I cannot imagine how you can manufacture these Faraway sets and sell them at your retail price. I have been interested in radio sets for several years and I recently had the privilege of "listening in" on one of your 4 tube sets and was surprised at the wonderful results. Send me your literature at once as I want to buy one.

M. N. JEFFERSON, Salt Lake City, Utah.

Got 30 Stations

Your 4 tube Faraway is fine. So far I've tuned in 30 known stations on the Loud Speaker. Send me a supply of order blanks and literature and expect many more orders.

A. E. CRAFTS, Pittsfield, Mass.

Frankly, I'm real enthusiastic about your Faraway two-tube set, and you may be interested to know that so far I have been able to get more stations than I can count.

Here are some of them:

KYW Chicago, WLW Cincinnati, WSAI Cincinnati, WOAT Wilmington, KSD St. Louis, WBAH Minneapolis, WJAZ Chicago, WOQ Kansas City, WMC Memphis, WHAM Rochester, WOO Philadelphia, WOS Jefferson City, KGO Oakland, Calif.

The range is all that could be expected and everything is loud and clear.

I am sure I will be able to sell a lot of them in the future.

Very truly yours,
E. R. CARTER, Forest Hills, L. I.

I have been using your 4-tube Faraway Radio set for some time now and I couldn't hope for better results.

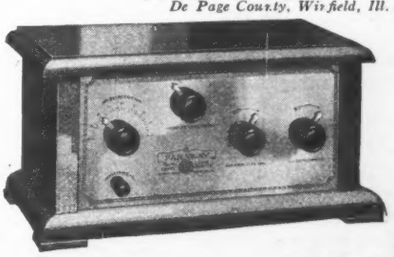
I have received as many as 21 stations in one evening, including New York, Pittsburgh, Schenectady, Chicago, Havana, Omaha, Los Angeles, Dallas.

Although I have gotten between 125 and 150 stations, I continue to get new ones each night.

I am 100 per cent Faraway now and I am making a lot of money, as you can see from my orders, selling others.

I would be glad to recommend the Faraway Radio to any one at any time.

Very truly yours,
FRANK A. COLLINS,
De Page County, Winfield, Ill.



MODEL R
2 tube set sells for only..... $29.50

MODEL F
4 tube set shown in illustration for use with loud speaker..... $59.50

MAIL THIS COUPON

THE FARAWAY RADIO CO.
653 W. 3rd St., Cincinnati, Ohio

Gentlemen:

Without obligation send me:

[ ] Your literature and details of money-saving proposition.

[ ] Agents' Proposition.

[ ] Dealers' Proposition.

Name.....

Address.....

City and State.....

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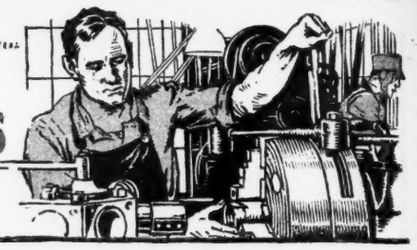
Better Shop Methods

How Expert Mechanics Save Time and Labor



How to Handle Rush Repair Work

Old Bill Uses Shortcut Methods in Machining

By James Ellis

Machine-Shop Superintendent

THE seven-o'clock whistle had blown some minutes before. Old Bill came into the shop through the side door, smiling to several of the men as he passed. It was pleasant to see his lathes and planers and drills cutting iron even before the night's chill was off.

He came to a lathe where a large piston was being turned.

"Looks as though you will have the piston ready by the time Conley gets the crosshead," he remarked.

"I guess I will," the machinist replied; "especially as Conley isn't here this morning!"

"What! Conley not here?" Old Bill exclaimed. "Where is he? We *must* have that crosshead!"

He pushed his old cap back on his head and looked about the shop to see whom he could best trust to finish the crosshead. It was an important job, and he could take no chances. "I guess Bob Laten will do," Old Bill mused; "he's young, but he *is* a careful fellow."

So it was not long before Laten was looking over the job that he was to tackle. He saw the broken crosshead he was to duplicate, and the new one in the lathe. It already had been planed.

In about two minutes, he was looking for Old Bill.

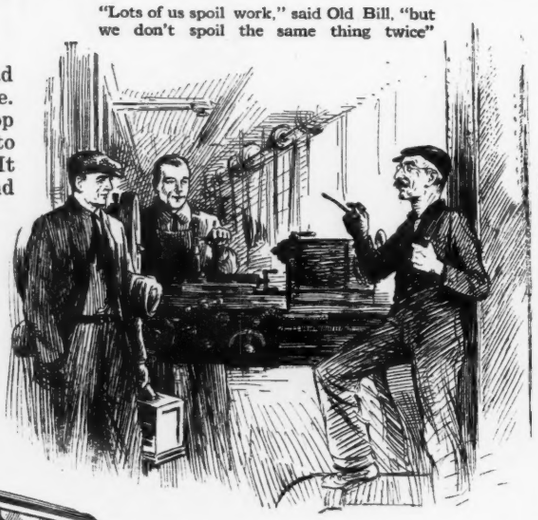
"This job's killed!" he said.

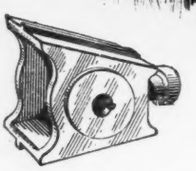
"Killed!" Old Bill gasped. "Why, that's for the light plant at Hughes, and we *have* to get it out. Let me see what is wrong."

"Conley has planed it so that we can't clean up the hole for the piston, for one thing," Laten explained, as he showed Old Bill the measurements. "And if we could, it is off center another way."

"IT'S no use to try to save that, boys," Old Bill said slowly to the group that had gathered. "This one is good for scrap, and the sooner we get the foundry making another, the better off we are. Bob, tell the foundry I say to make another one today, while I go and get bawled out over the phone."

"Lots of us spoil work," said Old Bill, "but we don't spoil the same thing twice"





The new crosshead

He had promised certain delivery on this job, and now he had failed. He would get another casting made, and in the morning he himself would see that no mistakes were made—at least, not in laying out the work.

The crosshead is illustrated above. The old one had cracked and finally broken. In the resulting wreck of the engine, the piston and cylinder head broke. This had put the engine out of commission and a neighboring town out of lights.

The following day Old Bill was on the job before the whistle blew. He went directly to the foundry to watch the new casting taken out of the sand. Two of his own men were there helping to clean it up. They soon had it in the machine shop and up on the table of a planer, still warm.

Old Bill came over with a sketch he had prepared.

"If Conley had made a little drawing of the job, the engine might be running now," Old Bill commented. "It is a mighty good idea to make some sort of a drawing of anything with as many surfaces as this, so that you can see all the dimensions before you while laying out the job.

"We will get the center of the boss end (Fig. 1), so that we will know that we have stock enough to clean up the hole. This is one place where Conley didn't leave enough. Then we will find the center lines on the other end (Fig. 2). Have to measure from the inside here, though, so that when we are through, both jaws will be the same thickness.

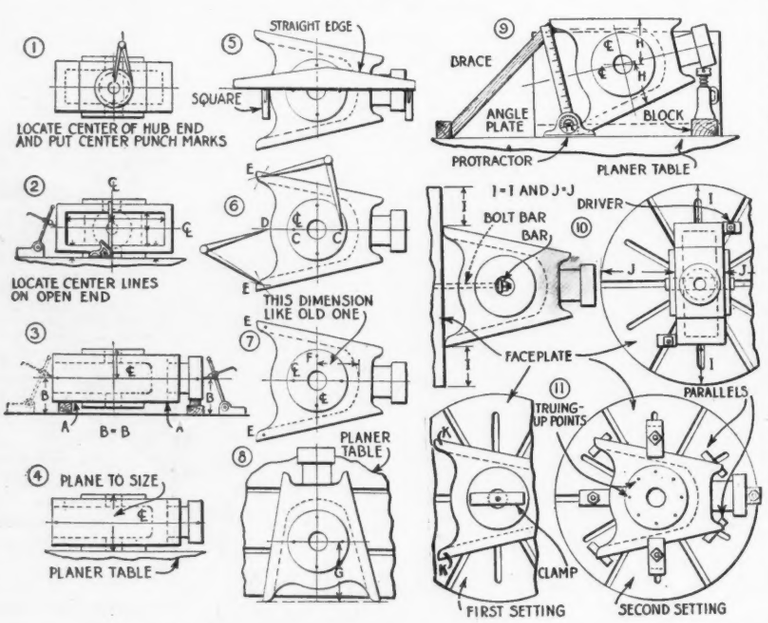
"Having done this, we will plane off one of the faces. Now, Bob, set up the casting so that the center lines we have just drawn are parallel to the planer table. Then draw a center line all the way around the casting with the surface gage."

Old Bill left to attend to other duties.

"I see where Conley made his mistake," Bob said to his helper. "He did not find the center line, but set the casting up for the first cut on two parallel strips here (*A*, Fig. 3). That threw everything out."

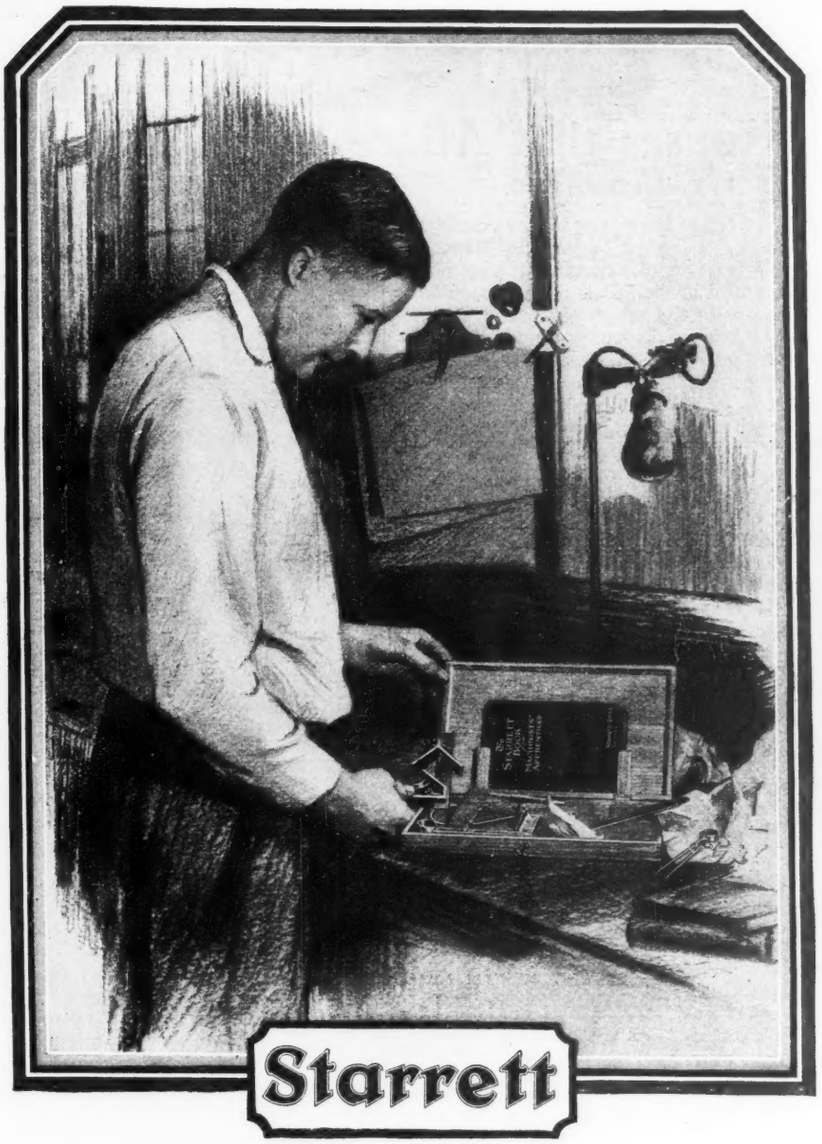
By the time Old Bill got back, Laten had planed both sides of the casting to the finished

(*Continued on page 138*)



The steps followed in laying out and machining the crosshead. Speed in handling work of this kind depends upon an accurate layout and a systematic plan of operations

DON'T fail to turn to pages 130-140, where you will find the continuation of the Better Shop Methods Department.

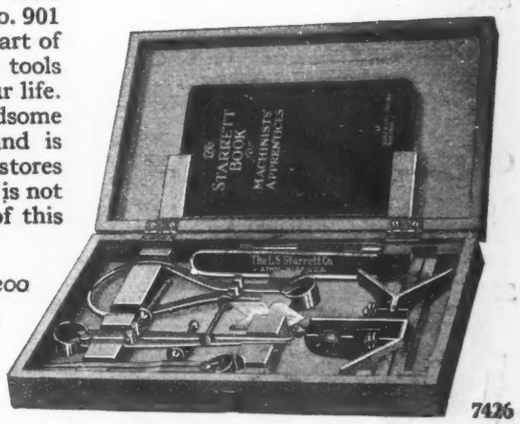


Are The Best Tools Too Good For The Beginner

Apprentice Set No. 901

When you learned to ride a bike you begged or borrowed from one of the kids an old wheel to practice on. That is, you did if you were wise.

But you can't learn a trade that way. You must have *accurate* tools to do accurate work and any mechanic will tell you so. That's why crack machinists advise the youngster to start with his own kit of Starrett Tools—the same fine tools they use themselves. In the No. 901 Apprentice Set you get the start of a kit of well-made, accurate tools that you'll use the rest of your life. The Set is contained in a handsome nicely finished wood case and is sold by good hardware stores everywhere. *At* a price which is not the least attractive feature of this splendid kit.



7426

Write for Starrett Catalog No. 23 "W" describing the uses of 2200 Fine Precision Tools. Free.

THE L. S. STARRETT CO.

World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.

Set No. 901 consists of: No. 11, 6-inch Combination Square complete with Sliding Head and Center Head; No. 117 B, Center Punch No. 320, 6-inch Flexible Steel Rule in Pocket Case; No. 390, Center Gage; No. 79, 6-inch Outside Caliper with Solid Nut, No 73, 6-inch Inside Caliper with Solid Nut: No. 77, 5-inch Divider with Spring Nut, and the Starrett Book for Machinists' Apprentices, Vol. I

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Red Devil Tools Better Made

ZIP!

and the glass is cut clean and sharp

No fumbling, no guesswork — no flaking or breaking of glass with the "Red Devil" Glass Cutter. Simply draw the tool lightly across the pane of glass, and you have a clean, continuous cut superior to that of a diamond cutter.

The "Red Devil" steel wheel glass cutter makes the diamond expensive and old-fashioned.

"Red Devil" Glass Cutters

It's All In the Wheel!

—each one separately hand honed and tested — the only one of its kind made. Ask any glazier what he thinks of it.

No. 024— shown here, the glaziers' standard 20c each.

Fix It Yourself with a "Red Devil" Plier

You can make and mend hundreds of things with it. "Red Devil" Slip Joint Plier No. 850, with side cutter, is handy for keeping things in order. Drop forged from steel.

No. 850— 5½ in. $1.35 a pair.

Look for the "Red Devil" trade mark on every tool. Then you'll be getting the same tools the skilled mechanic uses. On sale at all hardware dealers.

Write for free mechanic's tool booklet.

SMITH & HEMENWAY, CO., INC.

Mfrs. of "Red Devil" Tools

264 Broadway, New York, N. Y.

"Red Devil" Rapid Boring Auger Bits are 33⅓% easier boring, have 10% greater clearance, and bore with or against the grain of any wood. Style 2400—10|16 in shown here. 80c.

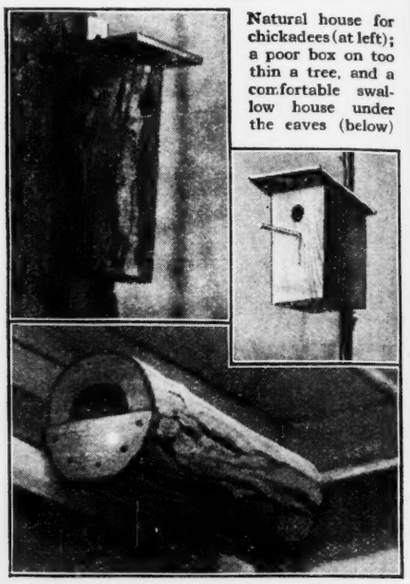
The Home Workshop

Houses that Allure the Songbirds

By Ernest Bade, Ph.D.

ON ONE of those long winter evenings when you turn to your workbench for a few hours of amusement, why not build a bird house? It is not too soon to get ready for the return of the songsters, for January and February are the proper months, contrary to general belief, for hanging up bird houses.

There is more to making successful nesting homes than one is apt to think. Boxes roughly knocked together and attached in any location that happens to be handy are useless. Even a good bird house will have no feathered guests if it is hung on a long, thin, shivering pole or in an otherwise unsuitable location.



Natural house for chickadees (at left); a poor box on too thin a tree, and a comfortable swallow house under the eaves (below)

The birds seem to prefer houses built entirely of wood. The cavity dwellers fancy a house like a woodpecker's hole, with a narrow opening at the top and a large oval cavity at the bottom. The entrance hole, however, should be adapted to the size of the bird that is to use it.

An ideal home for wrens (above) and a starling or woodpecker house, which must be quite large (at right)

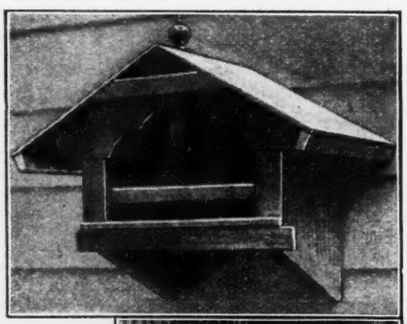
Bird houses should be hung perpendicularly with the entrance hole facing the west. They should be fastened rigidly so as not to rock violently in the wind.

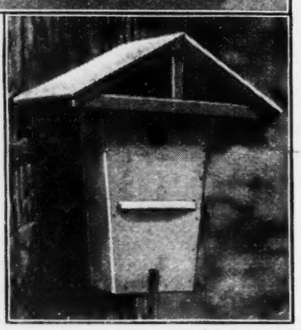
Chickadees prefer to build in fruit trees where plenty of underbrush is found. The house should be attached about 12 ft. above the ground and partially concealed in the foliage. Underbrush is necessary, since these birds do not like to fly over long stretches of open ground.

Birds that dwell in deep cavities, such as bluebirds, require houses that are partially open. Swallows and other related species prefer long, horizontal nesting places. These may be attached beneath gables or eaves of houses, well protected from the rain.

Birds may not appreciate architectural efforts, but it is just as well to make their houses neat and attractive.

Common sparrows are the enemies of songbirds and should be discouraged.





An open robin shelter placed against the wall of a house (above), and a well designed bird house for either wrens or chickadees (at right)

Wrench Prevents Staples from Bending under Hammer Blows

IN DRIVING the staple for a barn-door hasp, especially if the wood is hard, the sides are almost certain to spread apart, causing annoyance and extra work. This can be prevented by placing a wrench over the sides of the staple before it is driven.

How to drive a hasp staple easily

Oak fence posts cause the same trouble in driving fence staples, but a thin wrench, carried along with the staples and hammer, will help.

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Cut your operating cost

THIRTY years' experience in the manufacture of dry batteries has enabled us within the past two years to steadily and greatly improve dry "B" Battery quality. Eveready "B" Batteries are now from two to three times better than ever before.

Eveready "B" Batteries are unsurpassed for endurance, economy and reliability as a source of plate current. These are strong statements, but they have been proved by tests in our own and in independent laboratories. Check them for yourself on your own radio set. Get Eveready "B" Batteries.

There is an Eveready Radio Battery for every radio use.

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, INC.

Headquarters for Radio Battery Information

New York San Francisco

Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY
Radio Batteries
—*they last longer*

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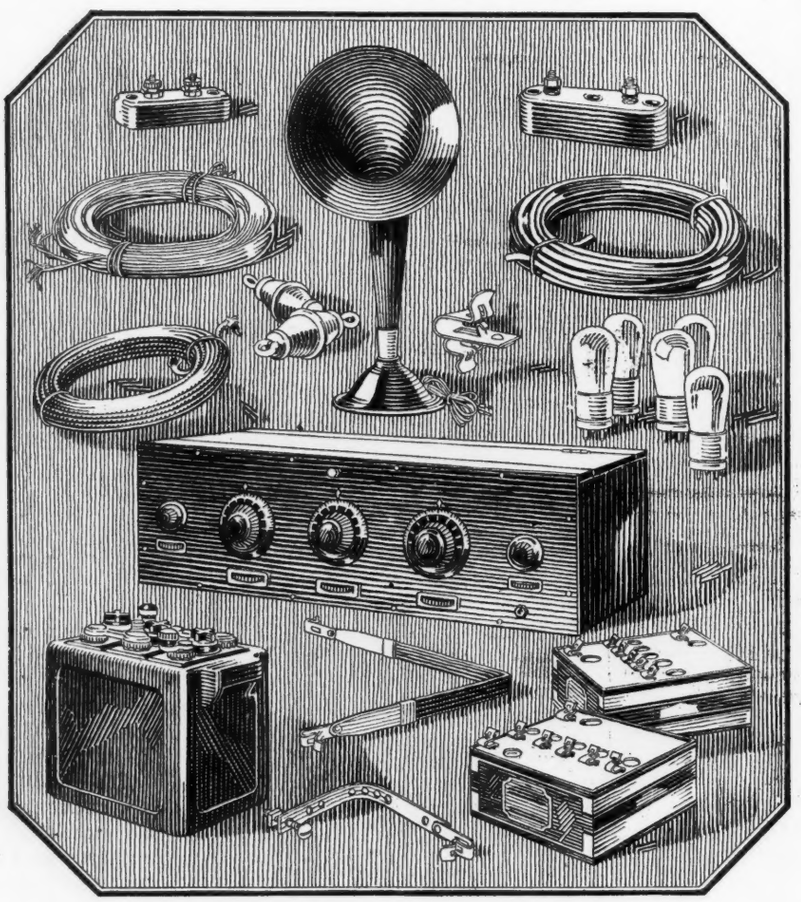
Which would

This →

"WITHOUT ACCESSORIES"

Radio instrument	*Loud speaker*	*Ground clamp*
Antenna wire	*Window lead in*	*Antenna spring*
Connection wires	*Mechanic's labor*	*Hammer*
Clips	*Storage battery*	*Nails*
Lightning arrester	*"B" batteries*	*Screws*
Insulators	*Tubes*	*Staples*
	Your time	

Separate price for each of these items.



What "complete self-contained"

IT is the best of fun, we admit, to hook up a radio set, to string your antenna from tree to house, to connect your ground wire—at least it is fun if you are mechanically minded.

If, however, you want principally to *use* a radio set there are two things of primary importance—*first*, that its tone quality shall be absolutely pure, non-metallic and accurate; *secondly*, that it shall be as little fuss and bother to you as is humanly possible. This means De Forest D-12 Radiophone—the leader in the field—bearing the imprint of Dr. Lee De Forest, the man whose great invention paved the way to radio broadcasting.

As to tone—it is impossible to describe the clean and natural tone quality which this instrument gives. You simply must hear it and judge

IS

DE FOREST RADIOPHONE

REG. U.S. PAT. OFF. REG. U.S. PAT. OFF.

IS This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 31.

you choose?

DE FOREST D-12 RADIOPHONE
Complete in one unit, with everything necessary to use it immediately—all at the one initial cost.
Prices according to cabinet finish and batteries.

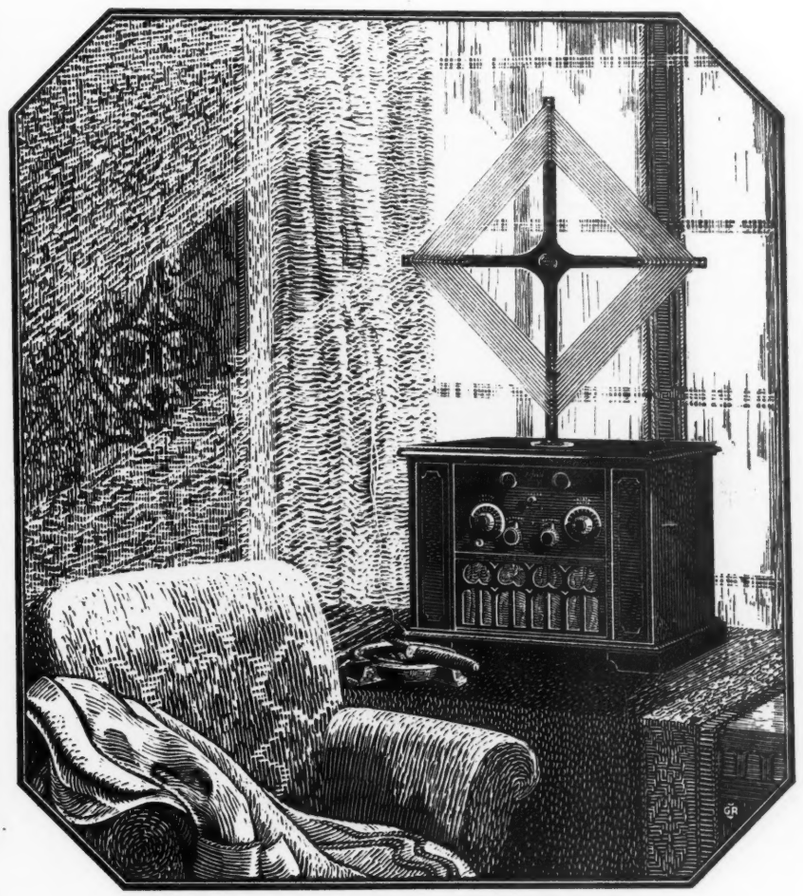
With dry batteries

In Fabrikoid cabinet	$161.20
In Mahogany cabinet	176.20

With storage batteries

In Fabrikoid cabinet	$180.00
In Mahogany cabinet	195.00

← *or this*



means as in De Forest

for yourself. And as for convenience, remember these important things: it is self-contained and complete in one unit—usable within five minutes after it enters your home—easily movable from room to room because it does not need to be attached to either antenna or ground.

When you find the De Forest agent in your vicinity you find a man who knows radio—a man who has given us his word that he will see that every instrument he sells is thoroughly inspected and properly serviced after the sale.

Avail yourself of his help. He desires, as we do, that you should get the fullest enjoyment and satisfaction from your instrument.

DE FOREST RADIO COMPANY, JERSEY CITY, N. J.

Also makers of De Forest Tubes, The "Magic Lamp" of Radio

Ⓘ

DE FOREST RADIOPHONE

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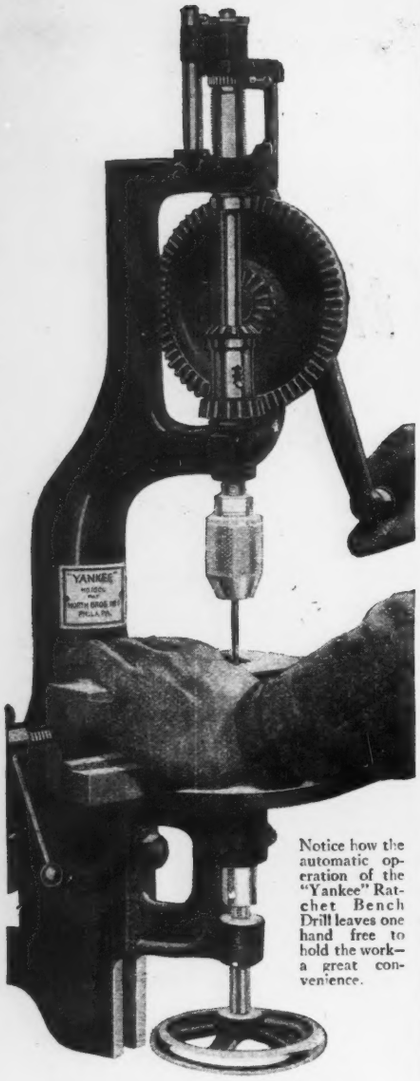


Notice how the automatic operation of the "Yankee" Ratchet Bench Drill leaves one hand free to hold the work—a great convenience.

Away goes drilling trouble

THE "Yankee" Automatic Friction and Ratchet Feed takes the place of hand feeding. Saves drills.

Just turn crank and Friction Feed runs drill down to work; then Ratchet Feed automatically operates and feeds *at the proper rate, with the right pressure.*

Automatic throw-off prevents jamming.

"YANKEE" Ratchet Bench Drill

No. 1005. Illustrated. Two Speeds, 3-jaw chuck. Holds up to ½ in.

No. 1003. One Speed, 3-jaw chuck. Holds up to ¼ in.

"YANKEE" Vise No. 990

For use on bench drills and other machines. True on all sides. Swivel jaw. Jaws 2⅝ in. wide, 1⅜ in. deep.

Dealers everywhere sell "Yankee" Tools
Write for FREE "YANKEE" Tool Book

"YANKEE" TOOLS

Make Better Mechanics

NORTH BROS. MFG. CO., Philadelphia, U.S.A.

The Home Workshop

Salvaging a Worn-Out House Furnace

By Lawrence B. Robbins

THE furnace-man shook his head after inspecting my old hot-air heater.

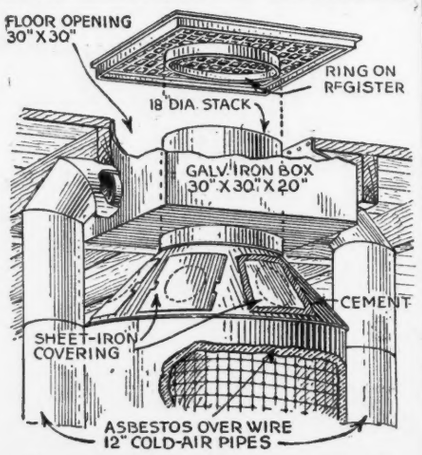
"This furnace isn't even worth taking in trade," he said. "Firebox is cracked, casing pretty well rotted out, an'—fact is, she ain't much use. Tell you what I'll do—I'll 'low you $10 fer old junk an'—"

"Nothing doing," I expostulated, for I had suddenly become possessed with an idea.

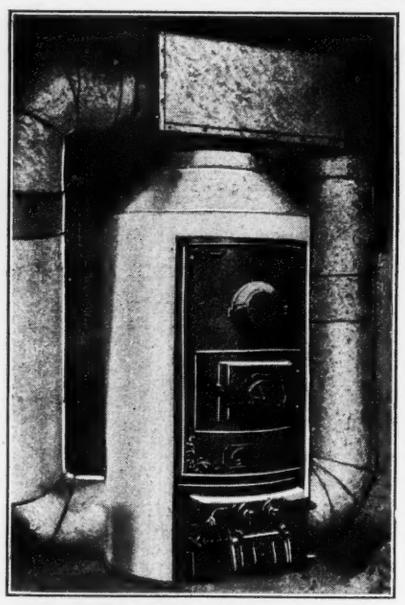
To begin with, this particular heater *did* have a cracked firebox, and so on; but I knew there were ways of mending such things. Then again, the single-pipe or "pipeless" furnace had just come into vogue in our neighborhood. I wondered if I could change this old-style coal-eater into an economical single-pipe furnace.

That afternoon I took down the register and the smoke pipes and cut off the casing bolts with a cold chisel, as the bolts had been burned tight after 15 years of exposure to heat. As fast as the scale and soot were removed from one section, I inspected it for cracks, which I closed solidly with iron cement.

Then I chose the spot in the house for the one big register and proceeded to reassemble the furnace directly below it. The ashbed section was cemented to the floor to prevent air from entering underneath and the sections were made gastight at the joints with stove putty.



The construction used for connecting the old furnace to a standard single-pipe floor register



The rebuilt furnace, which uses one-third less coal than before it was reconstructed

The casing was replaced with new bolts and a small length of wire wound around each one, the use of which will be explained further along.

The bonnet, or top conical casing, then was altered. The heater pipe stubs were removed and each opening was closed with a plate of sheet iron with a little tab at each side to hold it in place. The joints were made absolutely tight with stove putty.

The bonnet before remodeling

Next, the entire circular top of the bonnet was removed, a 3-in. stub clinched in the opening, and the bonnet put in place over the furnace.

The method of returning the cooled air to the heater puzzled me at first, but finally I hit upon the solution. I had the galvanized iron box shown above made at the tinsmith's. This was nailed inside a 30-in. square opening cut in the floor and placed so that the two 12-in. stubs came at opposite sides of the furnace door. These stubs were connected with two similar stubs fitted in the bottom of the casing by 12-in. pipe and elbows, shown in the large photograph.

A stack slightly more than 18 in. in diameter and 24 in. high was fitted to the stub over the top of the bonnet and to the circular ring on the floor register. The register was laid in place and the assembly was complete.

The casing was covered with 1-in. mesh poultry wire, pulled tight and secured by the little wires previously mentioned.

The netting was covered with an inch of asbestos meal mixed with water to form a thick paste. This was allowed to dry a week and then, after the smoke pipe and dampers had been connected with the furnace, a gentle fire was built and kept going all day. The result was a pure white coating for the entire furnace except the door facing.

A new one-pipe furnace would have cost about $150. I rebuilt the old one in spare time at a total cost of less than $45, including the new register facing, which was $12.

Since this change I have heated my house on one-third less fuel and have gained 50 per cent in heat.

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Meet the MAGNAVOX Radiotikes

A book the whole family will enjoy—sent free on request

THE new Magnavox Receiver has assumed a place of acknowledged leadership among the enduring radio achievements of the year.

The Magnavox **one dial** Station Selector means that anyone can now command a degree of selectivity previously limited to the expert. You probably have your own ideal of what a radio receiver should accomplish. Investigate the *Magnavox* and find that your ideal has come true.

Reliable dealers everywhere carry Magnavox Radio Products in stock. If unacquainted with the Magnavox store in your vicinity, write us for information and literature.

ILLUSTRATED above is the Magnavox Radio Receiver TRF-5, a 5-tube tuned radio frequency circuit encased in handsomely carved mahogany cabinet. This set, without tubes or batteries, represents remarkable value.

An accessory for the TRF-5 is the M4 Reproducer (also illustrated).

Magnavox Radio Receiver TRF-50 has the same circuit and panel enclosed in carved period cabinet with built-in Reproducer.

MAGNAVOX
Reg U.S. Pat. Off.

1R

THE MAGNAVOX COMPANY
OAKLAND, CALIFORNIA

New York: 350 West 31st St. *Chicago:* 162 N. State St. *San Francisco:* 274 Brannan St.

Canadian Distributors Perkins Electric Limited, Toronto, Montreal, Winnipeg

The Magnavox Co.
350 West 31st St., New York

Send me a complimentary copy of Radiotikes, the "funny people" of radio.

Name.....

Address.....

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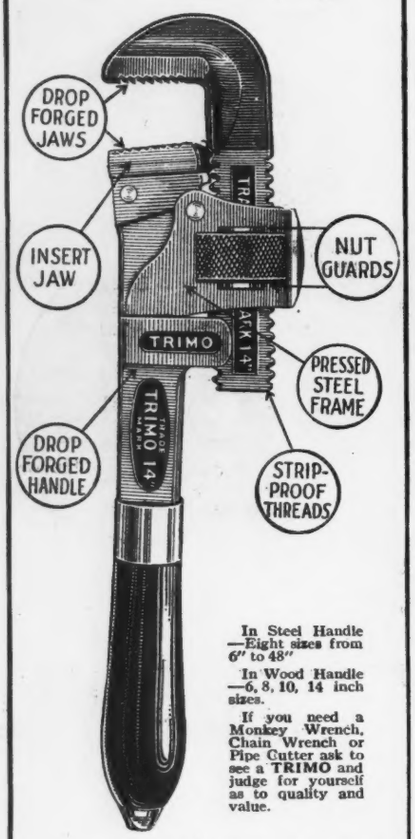
TRIMO

Turns Anything That's Tight



In Steel Handle —Eight sizes from 6" to 48"

In Wood Handle —6, 8, 10, 14 inch sizes.

If you need a Monkey Wrench, Chain Wrench or Pipe Cutter ask to see a **TRIMO** and judge for yourself as to quality and value.

Endorsed by The Popular Science Institute of Standards

Keep a **Trimo** handy. It will tighten up or loosen anything that's round or square or in between and it saves you many a penny, many a minute and many a "cuss word."

The **Trimo** is built for men who are particular about their tools. Superior design and finest materials and workmanship make it a satisfaction to own and a joy to use this wrench.

And it's really more economical in spite of the few cents saved by buying a cheaper wrench, because insert jaw in handle and all other parts are readily replaceable at small cost so that you can keep it as good as new indefinitely.

Your dealer will gladly sell you one. Just be sure and say **"a Trimo."**

Trimont Mfg. Co.

Roxbury, Mass.

IS 7451

TRIMO

The Home Workshop

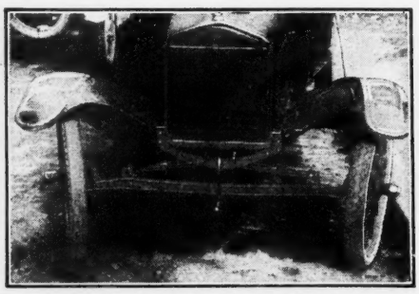
Alining the Wheels of Your Auto

By Ray F. Kuns

Principal, Automotive Trades School, Cincinnati, Ohio

I WAS coming into the city the other day when I noticed the car ahead of me acting in so queer a fashion that I had my suspicions of the sobriety of the driver. The car would appear to be going straight ahead when it would swerve 8 or 10 feet to the side of the road.

The driving was so erratic that it was dangerous to attempt to pass. Finally, selecting a place where the road was wide, I did pass and then stopped and flagged the driver. He seemed willing enough to stop. He had been in a slight accident and was still excited.



A car with excessive toe-in is dangerous to drive; any misalinement causes tire wear

I explained to him that his wheels were out of alinement and that to continue meant a certain wreck. We looked about and found a tough pole. This was placed over the front axle and used as a pry to straighten out the steering-reach rod. As this was pulled back into place, the wheels assumed a position more nearly their natural one. He was then able to proceed on his way with a degree of safety.

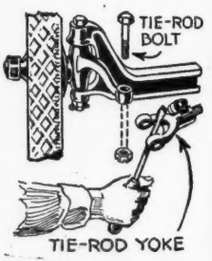
Bad alinement indicated by tire wear

In this case the wheels were out of line at least 6 in. It is about as safe to drive a car in that condition as to look down the barrel of a loaded gun. A car in this condition will jump beyond the control of the driver instantaneously. Even if a set of wheels is out of line less than an inch, there is undue tire wear and some danger of accident.

The illustrations show what is meant by excessive toe-in or wheels out of alinement. Wheels out of alinement may be too close or too far apart when measured across the front; either is dangerous. What happens to tires when wheels are not properly alined is shown in the picture of the worn tire. The wheels in this case were thrown slightly out of line by striking the curb. While not noticeable in the steering, the damage showed up on the tire tread within a few days.

The expert tire man will tell by the feel of your tire treads whether or not the wheels are out of line. Even if the wear is slight, the sharp edges on one side of the tread pattern will reveal it.

In alining front wheels, the first step is to loosen the tie-rod bolt through the yoke at the end of the steering-reach rod and remove it. Since the yokes are clamped on the threaded portion of the reach rod, it will be necessary to loosen the clamp bolt and then turn the yoke on or off, depending on the amount and way in which the wheels are misalined.



Adjusting the yoke

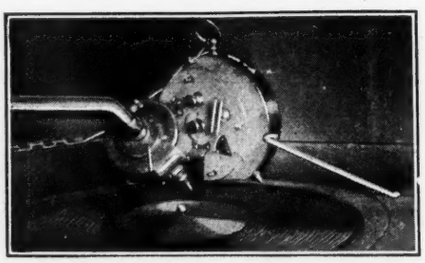
The center of the tires must measure from ¼ to ⅜ in. closer at the front than the rear. Set the wheel on a jack and mark the center of the tire by holding a soft lead pencil against the tire as it spins. Measure with a stick.

When the proper alinement has been obtained, the tie-rod bolt is cleaned and replaced, the cotter-key inserted, and the clamp bolt locked tight.

Phonograph Record Replaces Noisy Alarm

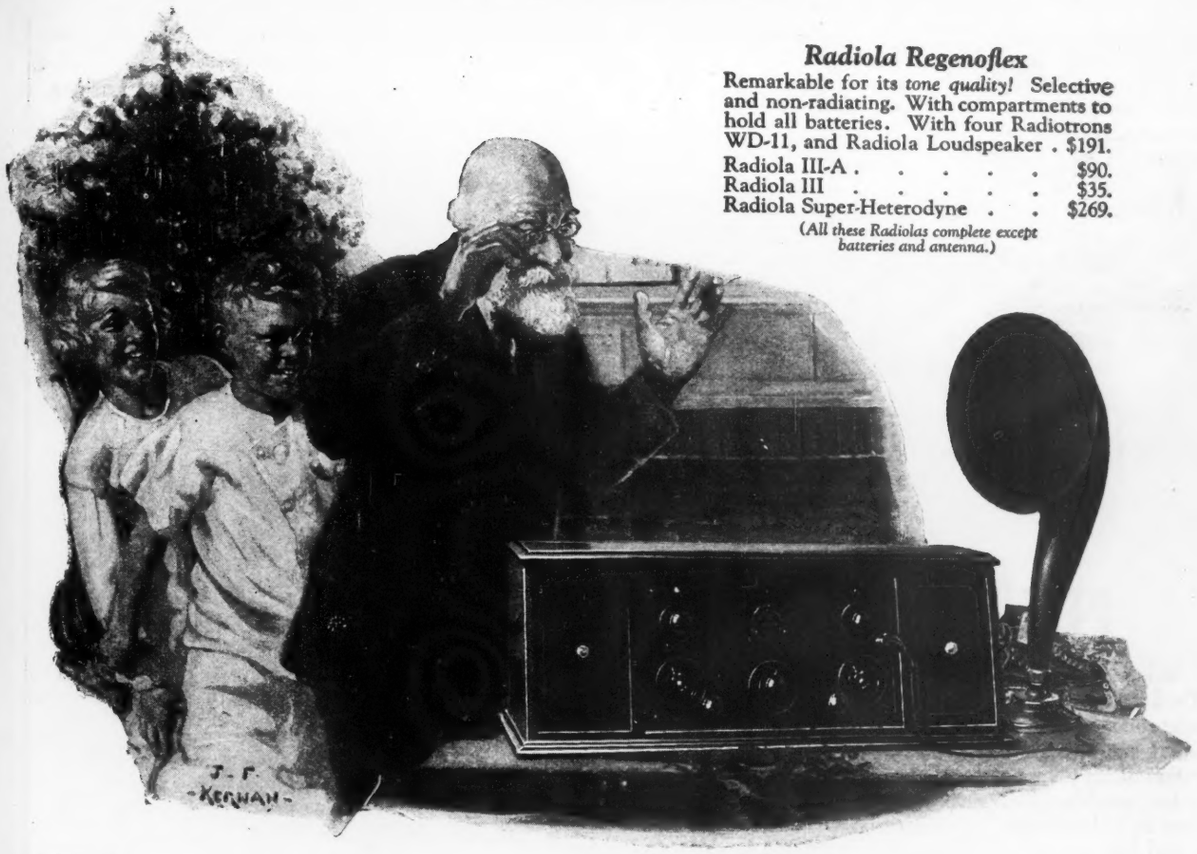
ONE morning, as I was awakened by the rasping call of the alarm clock, I decided to try a new way, so I rigged the old alarm clock to the phonograph and now I awaken to music.

The bell is removed from the clock. One end of a piece of thread is tied to the alarm winding key; the other end is tied to the starting lever of the phonograph. The thread should be very light so that it will break when the starting lever is pulled back. A stout string should be attached to the top of the clock to hold it steady.



The alarm-winding key winds up a thread attached to the phonograph starting lever

As the alarm winding key in the back of the clock turns to the left, it winds up the thread and pulls back the starting lever. Then the thread breaks, leaving the phonograph running.—S. D. SNAVELY.



Radiola Regenoflex
Remarkable for its *tone quality!* Selective and non-radiating. With compartments to hold all batteries. With four Radiotrons WD-11, and Radiola Loudspeaker . $191.

Radiola III-A . . . . . $90.
Radiola III . . . . . $35.
Radiola Super-Heterodyne . . $269.

(All these Radiolas complete except batteries and antenna.)

Christmas *is* Christmas —with a Radiola

A Radiola stretches away through the narrow walls of the city apartment. It makes a new world of the old farm kitchen. It reaches out and out, and brings home the fun!

There'll be Christmas carols on Christmas morning. There'll be music and laughter and lectures and sports—day after day—week after week. The new generation will grow up with a bigger world to live in. The older generation will get new joy out of life. *Everybody* wants a Radiola!

"There's a **Radiola** *for every purse"*

Ⓘⓢ

Radio Corporation of America

Sales Offices:

233 Broadway, New York
10 So. La Salle Street, Chicago, Ill.
28 Geary Street, San Francisco, Cal.

Radiola

REG. U. S. PAT. OFF.

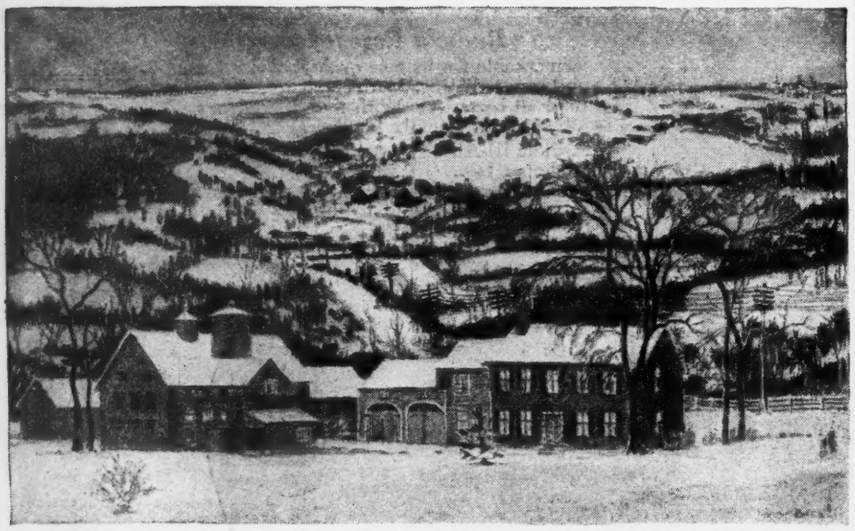
RCA

This symbol of quality is your protection

Want a Radiola This Christmas?
A gentle hint does wonders. Send us the name of the relative who doesn't know what to get you, and we'll mail to him—or her—a book about all the Radiolas from $35 to $425. It may help. *Or send for the booklet yourself for Christmas ideas.*

RADIO CORPORATION OF AMERICA
Dept. 111 (Address office nearest you)
Please send a Christmas booklet on Radiolas to
Name _____
Street _____
City _____
State _____ R.F.D. _____

Ⓘⓢ **This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS.** **See page 31.**



NEIGHBORS

When Ephraim Crosby made a clearing far out on Valley Road and built his house, he had no neighbors. He lived an independent life, producing on the farm practically all that his family ate and wore. Emergencies—sickness and fire and protection of his homestead from prowlers—he met for himself. Later he had neighbors, one five and another eight miles away. Sometimes he helped them with their planting and harvesting, and they helped him in turn. Produce was marketed in the town, twenty miles along the cart-road.

Today Ephraim Crosby's grandchildren still live in the homestead, farming its many acres. The next house is a good mile away. But the Crosbys of today are not isolated. They neighbor with a nation. They buy and sell in the far city as well as in the county-seat. They have at their call the assistance and services of men in Chicago or New York, as well as men on the next farm.

Stretching from the Crosbys' farm living-room are telephone wires that lead to every part of the nation. Though they live in the distant countryside, the Crosbys enjoy the benefits of national telephone service as wholly as does the city dweller. The plan and organization of the Bell System has extended the facilities of the telephone to all types of people. By producing a telephone service superior to any in the world at a cost within the reach of all to pay, the Bell System has made America a nation of neighbors.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
BELL SYSTEM
One Policy, One System, Universal Service

SIGNS, BANNERS, CARDS
Easily Painted with the aid of Letter Patterns. Simply trace around a letter pattern and fill in. Made in a large variety of styles and sizes at surprisingly reasonable prices. Send stamp for free samples. John F. Rahn, 02433 Green View Av., Chicago

8 HOUR BATTERY CHARGING
Brings trade to your shop. Pays $150 to $300 monthly profits. Only $35 cash brings complete equipment for 8 hour battery charging. Your big profits easily carry small monthly payments. No experience needed to build a big money-making battery charging business. Write for Free Bulletin 206.
Hobart Bros. Co., Box P1, Troy, Ohio

RADIO Buyers' GUIDE FREE
For Consumers 100 Pages
Get it now—before you buy any set or parts to build one. Just send your name. *Bargains in all kinds of complete Sets, Parts and Accessories* Will you be so kind as to add the name of one or more friends you believe will soon want radio goods? Thank you!)
Liberty Bl. O. House, Dept. A-184, 106 Liberty St., N.Y.

RECOVER IT YOURSELF
$3.85 AND UP Custom Made
Make your car look like new and save a big labor bill. We have been making top recoverings, side curtains and seat covers for 15 years. We have patterns for all makes, no model too old for us. Easy to apply, simple instructions given. Write for our big money saving catalogue with samples.
THE LIBERTY TOP & TIRE COMPANY, Dept. E-8, Cincinnati, Ohio

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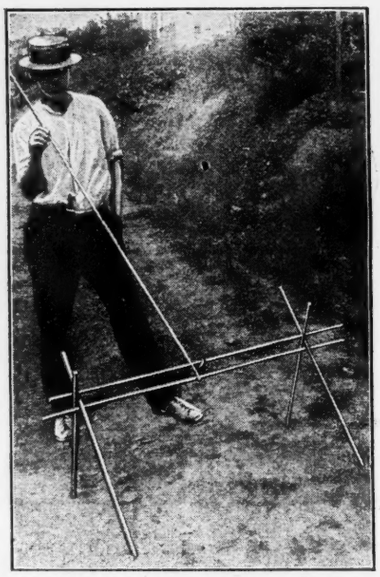
The Home Workshop

Unique "Dead Man" Anchors Aerial Guy Wires Firmly

MANY broadcast listeners, confronted with the problem of keeping their aerials up, resort to guy wires or ropes.

The amateur's method of anchoring guy wires, however, is nearly always most unreliable. Stakes driven into the ground should not be considered, as the swaying of the aerial mast eventually loosens if it does not pull them out altogether.

The strong and dependable "dead man" or anchor illustrated consists of six pieces of pipe, iron bar, or wood. It will be found impossible to pull out this anchor even if it is placed in very stony or loose earth.



Iron bars, pipe or strong wooden stakes may be used in constructing this "dead man"

The guy wire or rope is fastened first to the top horizontal bar, passed under the bottom horizontal piece, and then carried to the antenna mast.

In a test using a horse to pull against the anchor, spectators were dumfounded to see the horizontal bars gradually bent into a horseshoe shape while the stakes remained in the ground.

This anchor also will be of interest and value, no doubt, to campers who have trouble keeping their tents on one spot.—JOHN H. SCHALEK, Pittsburgh, Pa.

How to Waterproof Shellac

A SHELLAC finish on furniture or woodwork can be made fairly waterproof by the application of two or three coats of banana "oil." The last coat of shellac must be sandpapered as smooth as possible. Apply the liquid generously with a soft brush such as is used for varnish, and sandpaper each coat lightly. It dries with a dull finish, but this can be brightened by the application of furniture wax.

Many amateur woodworkers are partial to a shellac finish, but refrain from using it because shellac, unless specially treated, turns white from moisture.

Oh Boy—what fun! Big fights, sports, real music, talks crammed full of interest. All yours by radio—with a *Matched Tone* Headset!

The *Matched Tone* makes both ears hear the same sound at the same instant. It gives you every syllable—clear, lifelike, vividly real. Get the world's fun—and get it all—with a Brandes.

Brandes

Superior *Matched Tone* Headset $6
$7 in Canada

Table-Talker $10.
50¢ extra west of the Rockies
In Canada $12.50

Navy Type *Matched Tone* Headset $8
$9 in Canada

The name to know in Radio

Copyrighted by C. Brandes Inc., 1925

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CIR-KIT brings these Greater Circuits

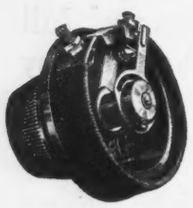
In a motor car—the engine. In a skyscraper—the substructure. In a radio receiver—the circuit. The circuit, Erla knew, must be the foundation of finest possible radio. So Erla first evolved those circuits which have ever since been rated inherently more powerful, tube for tube. Today's trend clearly indicates that Erla Supereflex may be selected in full confidence of continued pre-eminence.

That these fundamentally superior circuits are also easier to construct, with utmost economy, is another Erla attainment, made possible by the Erla *CIR-KIT*. With *CIR-KIT* you yourself can construct Erla Supereflex circuits from genuine Erla apparatus, specially designed to assure most efficient functioning of Erla Supereflex principles.

Erla *CIR-KIT* supplies everything needed, in a factory-sealed carton, sold under warranty. Erla Synchronizing Transformers, Erla Miniloss Condensers, Erla Precision Rheostats, Erla Cushion Spring Sockets, Erla Tested Crystals, and all the other matchless Erla units are provided. You can assemble them with perfect results virtually guaranteed by full-sized blueprints, drilled and lettered panel, stenciled baseboard, precisely locating every unit and connection. There is no soldering, thanks to Erla Solderless Connectors. Pliers and screwdriver alone are needed to bring you the de luxe radio of Erla Supereflex circuits, at lowest possible cost.

Electrical Research Laboratories
Dept. S, 2500 Cottage Grove Ave., CHICAGO

Erla Push-Pull Transformer is exclusive in core design and shielding. Indispensable for safe operation of high resistance loud speakers under full power. $10 pr.



Only the special spring arm, the perfected bearing and winding of Erla Precision Rheostats permit such supersensitiveness. Single-hole mounting. Price, $1.10.

Neatest, most convenient in form, Erla Autogrip 2-Way Phone Plugs assure smoothest connection of tips and most positive contact, with no manipulation. 75c.

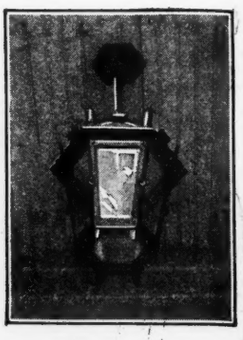
ERLA

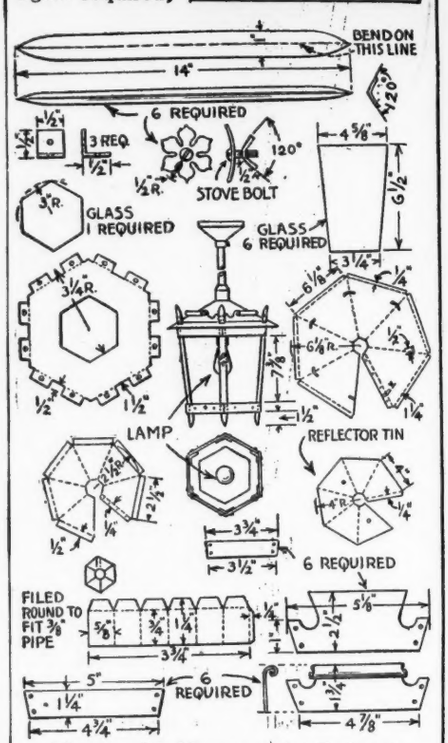
The Home Workshop

Distinctive Colonial Porch Light Constructed at Small Cost

IF THE porch of your home is one that would be improved by a so-called Colonial light, you can make the lamp yourself at a fraction of the price that a design of corresponding distinction and decorative quality would cost in an exclusive electrical shop.

The materials needed are of the simplest — sheet iron of about No. 20 gage; an 8 by 8 in. sheet of tin for the reflector; small rivets; a few small round-headed machine screws with nuts; a sheet of window glass large enough to cut the seven lights required;





The completed lamp and detail of parts

a piece of ¾-in. pipe, 1 in. long, fitted with a setscrew, and a piece of ⅜-in. pipe, 14 in. long, threaded at each end and fitted with a crowfoot and standard electric-light socket.

The hexagonal glass bottom is held in place by small ½-in. angles; the side lights are fastened by simple clamps, each of which consists of an angle, a stove-bolt and an ornamental rosette.

The ceiling canopy is supported by the short length of ¾-in. pipe, which is slipped over and fastened with a setscrew to the main pipe.

The ironwork is painted a copper color with burnt umber to which has been added a small amount of Venetian red.—WILLIAM J. EDMONDS, JR.

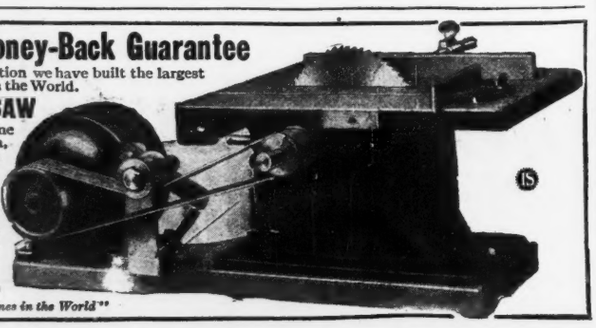
$25.00 in PRIZES See top of page 8 in front of book for details.

The Saw Sold on Money-Back Guarantee
Backed by a guarantee of satisfaction we have built the largest business in small bench machines in the World.

BOICE-CRANE JUNIOR SAW
This sturdy precision built machine will saw, sand, miter, rabbet, tenon, and many other operations with ease and accuracy. Saws 1⅛" stock. Driven by ¼ or ⅓ h. p. motor attached to any light socket.

Write for Descriptive Catalog on Bench Machines, Jointers and Band Saws.

W. B. & J. E. BOICE
Dept. P.S. 1 A, Toledo, Ohio
"Largest Makers of Small Bench Machines in the World"



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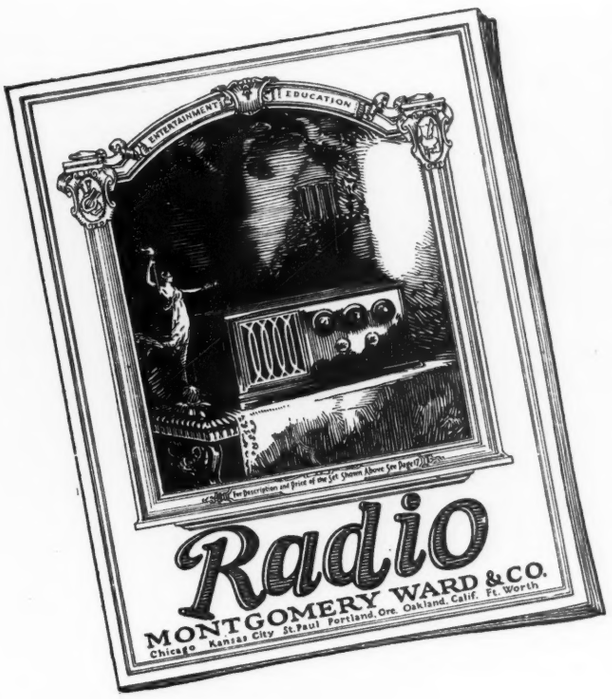
Write today for your free copy of

Ward's New Radio Catalogue



Tested and guaranteed Radio equipment sold without the usual Radio profits

WARD'S Radio Department is headed by experts who know and test everything new. Who know by experience what is best—what gives the best service.

Our catalogue is prepared under their supervision. It shows all the best hook-ups, everything in parts and complete sets—so simple that you yourself can install them in a short time.

Headquarters for Radio

Today Ward's is serving thousands upon thousands of Radio fans who have written for our catalogue, who have been surprised to see how low in price the standard Radio equipment can be sold without the usual "Radio Profits."

You, too, can profit by writing for a free copy of Ward's Radio Catalogue. If interested at all in Radio, you should write for this book. See for yourself the savings.

Our 53-Year-Old Policy

For 53 years we have sold quality merchandise. We never sacrifice quality to make a low price. In buying Radio Equipment at Ward's, you are buying from a house of proven dependability. Address our house nearest you: Dept. 5-R.

WARD'S Radio Catalogue is a big 68-page book—a real reference volume on quality Radio Equipment. In addition to descriptions of sets, parts and hook-ups, much matter of general interest to every radio fan is included. The book will prove fascinating to the confirmed radio enthusiast as well as to the beginner.

ESTABLISHED 1872

Montgomery Ward & Co.

The Oldest Mail Order House is Today the Most Progressive

Chicago Kansas City St. Paul Portland, Ore. Oakland, Calif. Ft. Worth

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I Learned From Big Investors

How to Become Independent in Only a Few Years on a Small Salary

"For years I thought it 'money-luck' by which big investors built fortunes," a successful investor wrote recently. "Then I was promoted to a position that brought me into contact with the confidential affairs of my employers. I was amazed to discover the secret of their investing—the legitimate methods they had used to build up fortunes in a surprisingly short time with safety!"

These remarkable methods are fully described in an important book called "Ali Baba's Cave Rediscovered." It outlines for you the most successful plan ever developed for the scientific accumulation of money. It tells you how to accumulate $10,000, $25,000 or even $50,000 in a certain length of time. It shows you how you can create a good sized estate through investing in Forman First Mortgage Real Estate Bonds—all without risk or speculation of any sort. Mail the request blank for your copy. It may change the whole course of your life.

GEORGE M. FORMAN & COMPANY

105 W. Monroe St., Dept. 831, Chicago
Pershing Sq. Bldg., New York
40 Years Without Loss to a Customer

MAILED FREE

First Mortgage Real Estate Bonds

George M. Forman & Company
105 W. Monroe St., Dept. 831,
Chicago, Ill.

Please mail me, without cost or obligation, a copy of your Free book, "Ali Baba's Cave Rediscovered."

Name_____

Address_____

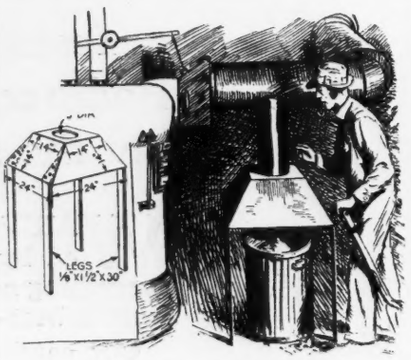
City_____ State_____

The Home Workshop

Hood Conducts into Chimney Dust from Furnace Ashes

ONE of the dustiest and most disagreeable jobs around the basement heating plant is the removing of the ashes from the furnace to the ash container.

The hood illustrated is a simple and efficient method of eliminating practically all of the dust. When you are ready to remove the ashes, place the ash bucket under the hood and open the damper in the pipe directly above the hood. Close the draft damper to the heating plant.



How the hood is built and connected with the smoke pipe of the heating plant

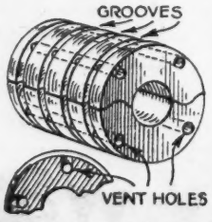
The ashes then can be shoveled unhesitatingly into the bucket; the dust that arises from them is sucked by the draft out through the smoke pipe.

The hood can be cut out of a piece of light gage galvanized or sheet iron about 40 in. square. The edges may be welded together or fastened by a small strip and rivets. Ten feet of ⅛ by ½ in. strap iron is cut into four legs of equal length and riveted or bolted to the hood.

A damper section of ordinary 8-in. stove pipe of proper length connects the hood with the smoke pipe of the heating plant. When not in use, the ash damper is kept closed.—WILLIAM F. SANDMANN, Indianapolis, Ind.

Preventing Canvas Belts from Slipping on Wooden Pulleys

WHENEVER canvas belts run at high speeds on small pulleys, such as are found frequently on threshing machines, corn shellers, hay bailers, and other farm machinery, there is always more or less slipping. This is due to the cushioning effect of the air.



Vents prevent formation of air cushions

The air cushions will not form, however, if ½-in.-deep grooves are cut around the surface of the pulley, by holding a saw against it, as shown, at intervals of 1 or 2 in., and holes are bored through the pulley from end to end so as to intercept the grooves. Through these channels the air will escape.—GEORGE MCVICKER.

Clarity and Tone Range with Kellogg Transformer

THE reproduction of the highest tones as well as those of the lower extreme of the scale, with faithful, pure quality is essentially the spirit of Kellogg transformer design.

The lover of better music searches for a rendition simulating the original orchestra. The ringing tones of brass, the mellowness of wood, the shrill of wind and the fan fare of reed, all in their individual expression.

The Kellogg transformer accomplishes this to a wonderful degree because of its perfect magnetic properties accomplished with the silicon steel laminations without punched holes

This feature, distinctly Kellogg, eliminates losses to a greater degree than could be otherwise obtained. A transformer is as good as its absence of losses.

Plainly marked terminals, brass shielding, moulded Bakelite tops, perfect finish, are further quality and design expressions.

Amplify your pleasure with perfect amplifiers.

Ⓘ *USE—Is the Test*

No. 501—4½ to 1 } Equally efficient. Price $4.50
No. 502—3 to 1 }

KELLOGG SWITCHBOARD & SUPPLY COMPANY
1066 W. Adams St., Chicago, Ill.

Big Value for 10 Cts.

6 Songs, words and music; 25 Pictures Pretty Girls; 40 Ways to Make Money; 1 Joke Book; 1 Book on Love; 1 Magic Book; 1 Book Letter Writing; 1 Dream Book and Fortune Teller; 1 Cook Book; 1 Base Ball Book, gives rules for games; 1 Toy Maker Book, Language of Flowers; 1 Morse Telegraph Alphabet; 12 Chemical Experiments; Magic Age Table; Great North Pole Game; 100 Conundrums; 3 Puzzles; 12 Games; 30 Verses for Autograph Albums. All the above by mail for **10 cts.** and **2 cts.** postage.

ROYAL SALES CO., Desk 213, Norwalk, Conn.

FREE

Fine Tone
$20 Musical Instruments

We have a wonderful new copyrighted system of teaching note music by mail! To first pupils in each locality we will give free a $20 superb Violin, Tenor Banjo, Ukulele, Hawaiian Guitar, Banjo, Mandolin, Banjo-Ukulele, Banjo-Mandolin, Cornet or Banjo-Guitar absolutely free. Also teach Piano and Organ. Very small charge for lessons only, - four lessons will teach you several pieces. Over 100,000 successful players. We guarantee success or no charge. Complete outfit free. Write today, Dept. 160. No obligation.
Slingerland School of Music, 1815 Orchard St., Chicago, Ill.

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CELORON
BAKELITE RADIO PANEL
Size 7 x 12
MANUFACTURED BY
DIAMOND STATE FIBRE COMPANY
BRIDGEPORT (Near Philadelphia) PENNSYLVANIA, U. S. A.
MAKERS OF
CELORON-Diamond-Fibre-VULCAWOOD
Offices in Principal Cities
IN CANADA, DIAMOND STATE FIBRE COMPANY, OF CANADA, LTD., TORONTO, CAN.
How to Work and Finish Celoron Bakelite Panels
DRAW full size layout of the holes to be drilled on a sheet of heavy paper, cut to exact size of panel. Transfer centers of holes through the paper to the Celoron panel with a pointed instrument.
The drilling can be done with a carpenter's brace or a breast drill, but metal-cutting twist drills should be used, not ordinary wood bits. Begin to drill from the front side of the panel. To avoid chipping on back, clamp panel to a board or work bench. Counter-sink holes with a larger size drill. Holes can be threaded with standard machine taps.
If a dull or mat finish is desired rub down the panel with No. 00 sandpaper. The sandpaper should be wrapped around a wooden block and the rubbing all done in one direction, not with a circular motion.
Wipe off the panel with an oiled cloth.

Will not soften with heat or deteriorate with age

Build your set around Celoron

Celoron is accepted as the standard insulating material by leading radio and electrical equipment manufacturers. It is the choice of more than a million radio fans.

USE a Celoron Panel in the next set you build. Insist on it in the set you buy.

The distinctive characteristics of Celoron are its mechanical strength, waterproof qualities, high insulating properties and machinability. Tests have proved that it is the ideal insulating material.

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A Celoron Panel gives you thorough, leak-proof insulation. It guards your instruments against loss of precious electric current. It improves the appearance of your set. It helps you get the best possible results from your radio hook-up.

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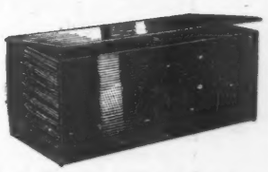
Celoron comes in eight panel sizes and in sheets, rods and tubes. There are four beautiful finishes—gloss black, a dull mat black, mahogany and walnut.

Send for FREE booklet

We have prepared an interesting booklet, "Getting the Right Hook-up with Celoron," which contains many helpful suggestions for building and operating a radio set. Send for one today, giving your dealer's name and address.

Wherever chimneys smoke and wheels turn, there are countless mechanical and electrical uses for Celoron and Diamond Fibre.



When you buy a kit, when you build a set, mount it in the first and only bakelite cabinet—the new Vulcawood Cabinet. It will furnish complete insulation. Its design and finish will give your set a snappy professional appearance.

TO DEALERS: Let your customers know that you handle Celoron Panels. This handsome display rack gets attention—it talks for you—it makes sales easier. Write for information regarding it.

Diamond State Fibre Company

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The oldest and largest manufacturer of vulcanized hard fibre and laminated bakelite materials in the world

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USE ONLY A

FIBROC PANEL

IF you want all of the good features a panel must have to be absolutely satisfactory.

Get these features in FIBROC-BAKELITE PANELS:

—*efficiency*

High dielectric strength assures freedom from distortion.

—*strength*

Though lighter than aluminum, FIBROC is stronger than steel of equal weight.

—*beauty*

FIBROC-BAKELITE PANELS are made in black or mahogany finishes with either a high lustrous polish or velvet finish that adds real beauty to the set of which it is a part.

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FIBROC-BAKELITE PANELS are sold in standard sizes, each in individual envelope, by better radio dealers. Ask for them by name.

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INDIANA

The Home Workshop

A Tandem-Steered Hill Racer

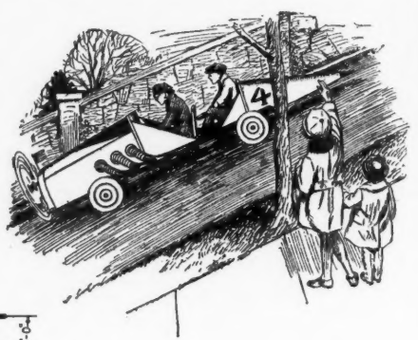
By Dale R. Van Horn

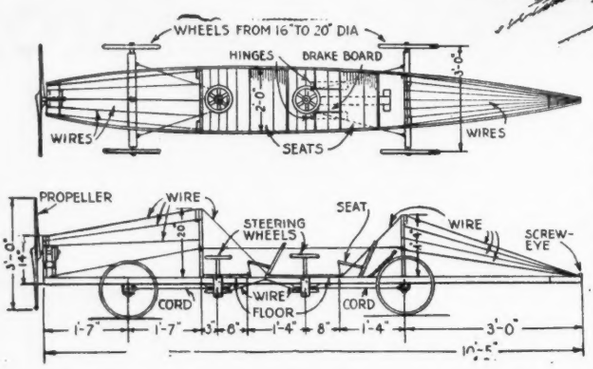
THIS racer is designed for either winter or summer use on hills. With unusually wide beam, it "hangs" to the ground and is so light that one boy can pull it uphill with ease. But perhaps its chief charm lies in the fact that it is steered somewhat after the manner of huge city fire trucks with two steering wheels.

The body is built of wooden strips and the frame covered with painted canvas or light-weight tin. The snug cockpit is neatly inclosed. If you wish, you can attach an air propeller in front.

Any boy handy with ordinary tools will find no difficulty in its construction. Here is a list of the materials required:

Two ⅝ by 3 in. strips, 11 ft. long.
Two 1½ by 2½ in. pieces, 3 ft. long, for axles.
Two 1½ by 3 in. pieces, 2 ft. long, for bolsters.
Four wheels from 16 to 20 in. in diameter, either all of the same size, or two pairs.
Two wooden disks or other wheels for steering.
Two broomsticks.
Four pie-tins, all of the same size.
Four wooden disks 1 in. thick and 1 in. smaller than the pie-tins.
A quantity of tongue-and-groove wainscoting or ceiling boards for flooring.
About 15 ft. of sash cord or equivalent rope.
Two ⅛-in. bolts, 6½ in. long, with washers.
Four lagscrews 6 in. long, with short pieces of gas-pipe to fit the wheel hubs unless the wheels already are provided with extra long hubs.
Sundry boards for cleats, seats, brake and the rest of the frame.
100 ft. of galvanized wire.
Enough canvas or tin to cover the frame.





For winter use runners are substituted for the wheels of this speedy racer. The top and side views appear above

The two 11-ft. side strips of the main frame are held apart at the back and front by flat blocks. That at the rear is a triangular block 2 in. thick, 8 in. long and about 5 in. wide. The side strips are nailed to this with their ends flush. The other ends of the strips are nailed to another 2-in. block 12 in. wide and 6 in. long. The sides of both blocks should be curved slightly to fit the general curve of the sides. This can be seen in the accompanying top view of the car.

One axle and one bolster piece, after being bolted together, are attached 18 in. from the front; the other pair are fastened 3 ft. from the back. The bolsters are held by nails driven through the side pieces.

Build three frames from 1-in. material, one for the front, another for the dash or front of the cockpit, and the third to fit back of the rear seat. These need no exact dimensions, though they should be slightly higher than they are wide. The detail on the next page shows how they are built up and assembled in place.

Now we are ready to truss the wires. Run one wire along each side, attaching the ends in screweyes as indicated and running them through other eyes turned into the cockpit frames, about 10 in. from the floor. These wires later form the side of the cockpit.

Through other screweyes, run wires from the tops of the frames down to the side pieces near the seats to counteract the pull of the several wires run from each end.

The two steering-wheels are mounted upon vertical broomsticks, which terminate just under the floor in special V-shaped pulleys made from the pie-tins. The steering-cord is placed about the pulleys, and the ends, after being drawn tight, are secured in stout screweyes set on the back of the front and the front of the rear axles, 4 in. from each end.

To make the pulleys, set the tins in pairs, bottoms together, and solder them. Cut wooden disks and place one on each side; then drive through them nails long enough to reach through the tin and the two disks. Be sure to close the bottom of the groove clear around with solder so the cord will not force them apart and bind when in use. To insure a positive grip between pulleys and cord, rub the cord with belt dressing.

Locate the centers of the pulleys and with an old wood bit, slightly smaller than the broomsticks to be used, bore holes through them. Use glue or two nails, driven at an angle, to lock pulleys and shafts.

Now spread the frame sides until they are two feet apart, midway between the ends, and nail on the floor boards, leaving spaces for the seats, which are built and

(*Continued on page 111*)

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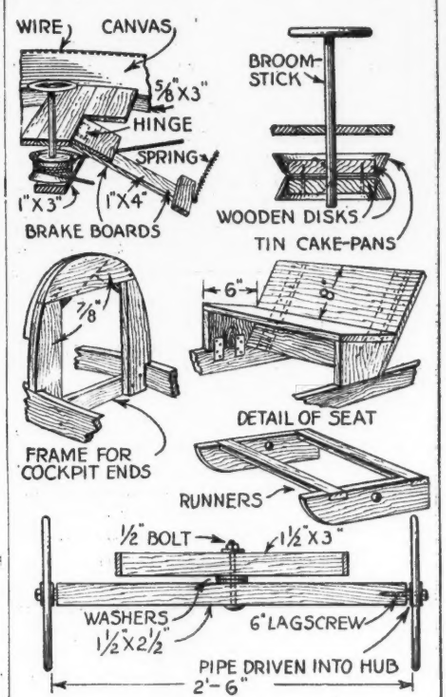
The Home Workshop

(Continued from page 110)

assembled as indicated by the seat detail. This done, bore holes for the steering shafts through the floor at the points indicated and midway between the sides, and support the lower ends by means of wooden strips with a hole through the lower cross piece for the lower end of the broomstick and with the pulleys between this and the floor above. Nail to the sides, then truss with short wires as indicated to offset the pull of the cord.

The steering columns should be vertical. The steering wheels may be old coaster wagon wheels or wooden disks cut for the purpose, bored and glued or nailed on the upper end.

Now finish placing the wires by running them from the ends to the curved upper portions of the cockpit frames, using small staples to hold them. These wires



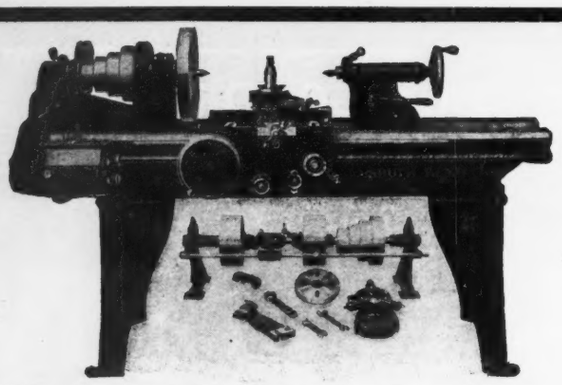
Details of the brake, steering mechanism, frames, runners, and wheel assembly

give the desired curve to the canvas or further support the tin, if used.

Build and attach the seats, and provide the brake, which is made by cutting out a portion of the floor just in front of the rear seat, cleating and hinging it at the forward end and nailing to this trapdoor a short board. This board is held horizontally by a spring attached to the rear cockpit frame. The spring also keeps the hinged portion of floor in place. Yet at a moment's notice, the rear rider can bring the racer to a complete stop by stepping on this portion of the floor.

Lay the covering in three sections. Cover first the front, placing the material on and marking where the cuts are to be made. Then fix the two side pieces; finally complete the rear. If tin is used, the edges can be crimped over the wire edges of the cockpit; if canvas is used, the edges should be sewed tightly over it.

(Continued on page 112)



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15" x 5'	360.00	415.00
16" x 6'	406.00	466.00
16" x 8'	438.00	498.00
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allows you to install a SOUTH BEND LATHE in your shop, by making one payment with the order; the balance to be paid month by month, the amount depending upon the size of the Lathe.

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12 Cells 24 Volts Solid Rubber Case

$3.50 COD SPECIAL

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For a limited time *only*, and to introduce this new and superior Storage "B" Radio Battery to the Public, we are selling it for $3.50. Regular Retail Price is $5.50. You save $2.00 by ordering NOW. A finer battery cannot be built than the

World Storage "B" Battery
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To ten million homes with Radio Sets—and to countless millions of prospective buyers—this WORLD Storage "B" Battery brings a new conception of battery economy and performance. Here is a battery that pays for itself in a few weeks—will last for years and can be recharged at a negligible cost. *And you save $2.00 by ordering now.*

A *Superior* Battery Equipped With Solid Rubber Case

Has heavy duty 21-8 in. x 1 in. x 1-4 in. plates and plenty of acid circulation. Extra heavy glass jars allow ready observation of charge and prevent leakage and seepage of current. It holds its charge, while idle, at constant voltage. You will find this battery a boon to long distance reception. It does away with a great many noises so often blamed on "static." Mail your order today.

SEND NO MONEY

Just state number of batteries wanted and we will ship day order is received. EXTRA OFFER: 4 batteries in series (96 volts), $13.00. Pay Expressman after examining batteries. 5 per cent discount for cash in full with order. Send your order NOW and save $2.00.

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Write for your **FREE** copy today!

The Home Workshop

Old Calendar Furnishes Figures for House-Number Plate

AN ATTRACTIVE house-number plate can be made at little or no cost from a 3 by 5 in. piece of glass and large black numbers, about 2½ in. high, cut from a discarded business wall calendar.

Stick the black faces of the figures to the glass with transparent glue or mucilage. When dry, coat their backs with the same adhesive, or, better yet, shellac. Next, apply one or more coats of white or some light-colored paint over the entire back of the glass sheet.

Figures are black against white

Fasten the plate to the building with four upholsterer's brass-headed tacks, driven in until the heads barely touch the glass.

The carbon in the printer's ink, backed by the paint, will remain black for a long time, and the combination of black on white makes the numbers stand out with exceptional clearness.—F. W. B.

Tandem-Steered Hill Racer

(*Continued from page 111*)

It will be well to provide a turnbuckle in each truss wire so that any slack can be taken up without delay.

If you wish a propeller, cut it from a 2 by 4 and mount it on a shaft supported as indicated in the side and top views. It should have at least 6 in. clearance above the ground. A propeller only 2 ft. in diameter will spin faster and weigh less than the one shown.

Two hooks should be set in the front and a 20-ft. tow rope with rings in each end kept back of the rear seat.

To use, two riders take the seats and grasp the steering-wheels. To turn to the right, the front rider turns the steering-wheel to the right, while the rider to the rear turns his to the left.

All sorts of stunts can be accomplished by this racer. For instance, when both steering-wheels are turned to the right and held there, the racer swerves from its path, then continues in a straight line but with the machine pointing to the left.

Of course you will wish runners for winter use. Build these in pairs, connected at the top of each end of the runners by cross pieces. Bore holes through the top edges near the center for the axles and put these on in place of the wheels, using the same lagscrews.

When the runners are used, it will be great sport to build a smooth snow track down some steep hill so that it terminates on the shore of a lake or pond. Then, by careful manipulation of the steering apparatus, great distances can be covered.

As soon as the racer is completed and you have tested it out, protect all parts with a coat of paint. Keep the steering cords tight and lubricate the steering columns well with hard oil.

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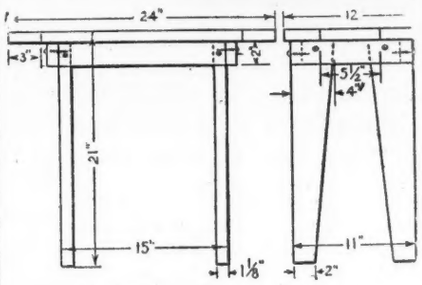
The Home Workshop

Useful and Attractive Benches Constructed at Little Cost

SMALL benches or stands, that serve many purposes in the home may be made quite easily. I have constructed two attractive benches from a single long board 1⅛ in. thick and 12 in. wide.

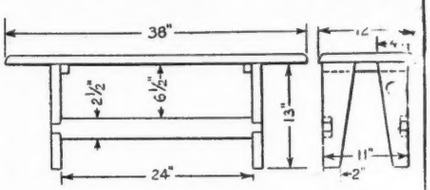
The way these were made is indicated in the accompanying illustrations. The four legs can be cut out in each case from one width of the board with a minimum of sawing. The tops are made



The pieces for making this bench are cut from a single wide board without waste

simply by sawing the board to length and cutting off the corners, the upper edges being rounded off smoothly. The benches are put together with glue and wood screws and then are painted neatly.

In this case the benches were first primed with one coat of flat white paint

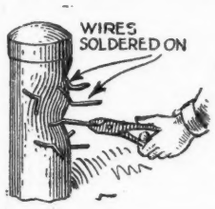


A low bench, which embodies another type of strong yet exceedingly simple construction

and then the ornamental designs, previously drawn on paper, were traced on them. Several 10-cent cans of different colored paints provided the coloring. The surface was given a final coat of clear varnish.—H. S. TRECARTIN.

Straightening Dented Tanks

ON VARIOUS occasions I have straightened copper floats and removed dents from sheet-metal tanks simply by soldering on a number of wires, as indicated and pulling the vessel back to its original shape. After the straightening is completed, it is a simple matter to remelt the solder and remove the wires.—N. G. N.



No. 111
Spiral-Ratchet Screw Driver
Price $2.50

The improved positive lock-nut permits automatic driving or drawing; will instantly convert it into a ratchet screw driver, or will lock it rigidly for use as a plain screw driver. Beveled edges prevent finger-pinching.

Steel spiral nuts and steel spiral, machined at a 20° angle.

Automatic screw driver *perfected with new features*

THIS screw driver sinks a screw with the least possible effort. The improved positive lock-nut permits automatic driving or drawing; will instantly convert it into a ratchet screw driver, or will lock it rigidly for use as a plain screw driver. Beveled edges prevent finger-pinching.

The spiral nuts and the steel spiral are made of hardened steel, milled at a twenty-degree angle. Thus this tool withstands unusually severe strains.

A conveniently located shifter knob controls the ratchet mechanism.

Three tool-steel blades—hardened, tempered and polished—are provided.

Length extended with blade in place, 18 inches. Length closed, without blade, 10 inches. Weight, 14 ounces.

What other tools do you need?

The Goodell-Pratt Catalog No. 15 shows the entire line of 1500 Good Tools—many of them particularly adaptable for the home work shop. Write for a copy.

GOODELL-PRATT COMPANY
GREENFIELD, MASS., U. S. A.

Toolsmiths

Makers of Mr. Punch

GOODELL-PRATT
1500 GOOD TOOLS

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SPEED!
and Adaptability

YOU'LL appreciate the way Snap-On Wrenches work—because Popular Science readers know the value of good tools.

Get a set for that car of yours—for your truck, motor boat or any machinery you have to keep in repair—and enjoy the tremendous satisfaction of working with wrenches that will run on or off any nut—anywhere—in the hardest-to-reach place—in jig time.

You can hold in one hand all the Snap-Ons you need—Snap-On engineers have selected the exact wrenches for each standard make of car—no more or no less than are absolutely needed—giving you the maximum in wrench service at a minimum price.

You can see Snap-Ons in action in almost any garage

Look for the name—without it no wrench is a genuine Snap-On

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Please send me full particulars about Snap-On Kit for.....car. (If interested in Master Mechanic's Kit, check here)

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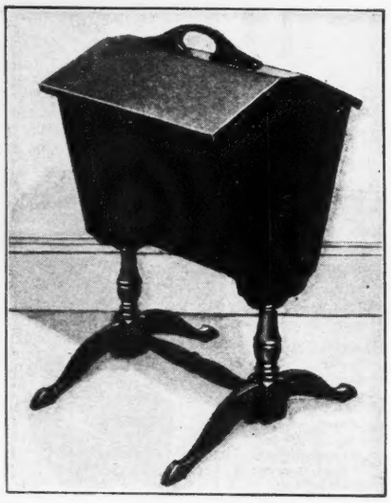
The Home Workshop

Priscilla Sewing Cabinet Is an Always Welcome Gift



FOR your next home workshop undertaking, why not try building a Priscilla sewing-box? It makes an attractive piece of furniture for the sewing-room, and being small and light, it can be carried into the living-room, sun porch, or any place where the always accumulating odd jobs of needlework may be done most comfortably and conveniently. Generations of use in American homes have placed the stamp of approval on the Priscilla cabinet.

The complete working details and bill of materials for a sewing cabinet of this type are contained in Home Workshop Blueprint No. 31, listed on this page. H. Caldwell, of Toronto, Canada, used this blueprint in constructing the cabinet illustrated. He writes:

My wife, who has wanted one of these for some time, is quite pleased with the result, and declares that it has not a bit of the "homemade" look. I am quite proud of this job myself, as it required a little more care than anything that I have yet made, though I would not call it at all difficult. I used walnut, and for a finish filled with a dark filler, gave two coats of shellac, rubbed down with felt and pumice, and then waxed. This gave a very fine satin finish.

The new blueprint for this month gives full size details and bill of materials for the table illustrated on page 89.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
250 Fourth Avenue, New York

GENTLEMEN:
Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....cents:

No.	*Title*	*Price*
1.	Sewing Table	25c
2.	Smoking Cabinet	25c
3.	Book Trough End Table	25c
5.	Kitchen Cabinet	25c
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30.	Tool Cabinet, Bench Hook, etc.	25c
31.	Priscilla Sewing Cabinets	25c
32.	Chinese Game Table	25c
33.	Pullman Dining Alcove	25c
34.	Trellises for House and Garden	25c
35.	Simplified Radio Cabinet	25c
36.	Rush-Bottom Arm-Chair	25c
37.	Simplified Bookcase	25c
38.	Sheraton Table	25c

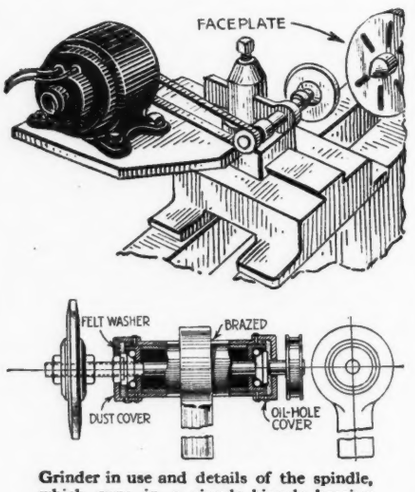
Name.....
(Please print)
Street.....
City and State.....

Lathe Grinding Attachment Made from Odds and Ends

IF YOUR home workshop equipment includes a small motor, it can be arranged for plain grinding on a lathe.

The motor is mounted on a slotted steel plate, which is clamped under the toolpost washer.

The wheel is carried in a special bracket with a shank to fit the toolpost. A front-wheel bicycle bearing is used for the spindle bearing. The outer casings



Grinder in use and details of the spindle, which runs in a simple bicycle bearing

are made from steam pipe, counterbored to receive the ball races. The ends of each casing are turned true in relation to the center line of spindle. The dust caps shown were found in the scrap pile.

The shank is forged and drilled to receive the bearing, which is brazed in place after it has been set square and clamped in position. The wheel spindle is driven by belt—in this case a rawhide belt lace. Adjustment of belt and wheel is made by means of the toolpost screw. The spindle may be made longer, for internal grinding, if desired. If a motor must be purchased, it would be better to buy a regular grinding attachment.

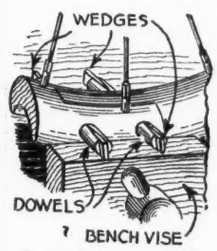
The Home Workshop

Using Dowels and Wedges to Make Difficult Repairs

JOINTS in woodwork that are especially difficult to fasten securely can be held in many cases with dowels and wedges.

This method of repair is illustrated in the accompanying drawing, which shows how I have fastened bicycle rims that had split at the joint. This is a fairly common repair, but is rarely made permanently and satisfactorily.

To repair a bicycle rim in this way, remove the wheel, take off the tire, and loosen the spokes directly over the joint. Hold the rim in a convenient position, force apart the leaves, and apply a thin film of glue over both surfaces.



Fastening permanently a split bicycle rim

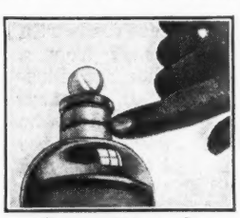
Place the joint in a vise so that about two-thirds of it is above the level of the jaws. Drill two holes of 5/16-in. diameter at such a point that they will all but penetrate the inside concave part of the rim. The holes should be ⅜ in. from each end of the joint.

Have ready two dowels cut with a dowel plate or turned. Be sure they are a snug fit. They should be ½ in. longer than is required. Through each end of these make two saw cuts parallel to each other and about ½ in. deep. Now make four wedges ¾ in. long and 5/16 in. wide. These should be as thick as the saw cut at one end and 1/16 in. wider at the other.

Apply glue to the holes through the joint and drive the dowels through the holes until they project equally on both sides, with the saw cuts parallel to the spokes. Glue the wedges and drive them into the saw cuts. Allow the glue to dry for at least 12 hours and then cut off the projecting dowels and smooth the ends, which may be painted to match the rest of the rim. Retighten the spokes and assemble.—I. H. C.

Blotting-Paper on Bottle Neck Prevents Stains on Labels

WHATEVER care is exercised in pouring chemicals from bottles, a drop or so of the solution occasionally will find its way over the lip of the bottle and destroy or badly discolor the label.


Any overflow is absorbed immediately

By tying or otherwise fastening a piece of blotting-paper around the neck of the bottle, any drops that flow over the lip will be absorbed. This prevents the discoloration of either label or shelf.

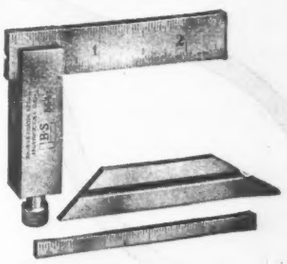
BROWN & SHARPE TOOLS

—For the Motor Mechanic

Here is an Inside Micrometer that is new. It has a clamp nut that locks the spindle at any reading. The No. 264 takes cylinder bore and other inside measurements from 2″ to 8″ by thousandths with ease and precision.

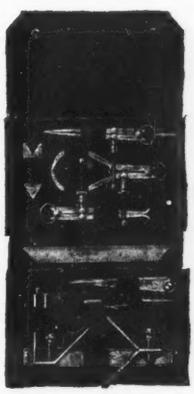
—For the Shop Mechanic and Toolmaker

A tool kit isn't complete without one of these handy Adjustable Squares. Blades are interchangeable and adjustable to any length. You will find the reversible blade feature of the Brown & Sharpe No. 554 gives it an added handiness.



Another new tool that proves its worth is Brown & Sharpe Thread Tool Gauge No. 577. Adjustable, for cutting tools, from a sharp "V" to a 1″ flat. Made with three different angles—60°, 55°, or 29°—and remarkably inexpensive.

—For the Apprentice and Home Mechanic



Set of Tools No. 847 is one an apprentice or home mechanic finds that answers his requirements. They have been especially chosen for the requirements of the beginner or home mechanic. This set represents an outfit of high quality tools at a moderate outlay. Tools are furnished in a neat, felt lined, leather case which helps to protect them from injury, dust and moisture.

Our new No. 29 Small Tool Catalog lists all the above and over 2000 other tools. It's a buying guide every tool user ought to have. Copy sent on request.

IS

Brown & Sharpe Mfg. Co.
Providence, R. I., U.S.A.

"Standard of the Mechanical World"

KLEIN PLIERS

Did you ever notice that the fellow who turns out the professional looking jobs—is a crank about the pliers he uses? Next time you're around, drop into your hardware store and get the feel of a pair of Klein's in your hands—then you'll know. They've been standard in big electrical companies for over half a century!

Mathias Established 1857 KLEIN & Sons Chicago In USA

FAHLBERG
MADISON, WIS.

For Perfect Conductivity in Radio It is now possible for the amateur to get tight, clean joints in his home soldering that make the perfect conductive path necessary in radio work. Mr. E. D. Fahlberg, former Professor of Metallography at Wisconsin University and Metallurgical Engineer with Western Electric Co., has developed Reddy Hot, the complete home soldering furnace. Heats iron in *two minutes — non-explosive — Burns denatured alcohol.*

Reddy HOT

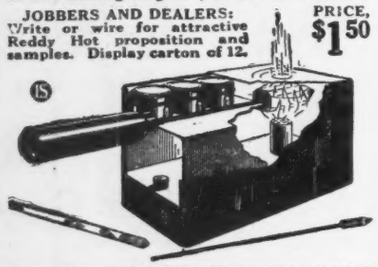
Soldering Furnace and Tested Supplies

Reddy Hot Soldering Outfit consists of: Large soldering copper, detachable handle—Fine soldering copper—Reddy Flo Household Solder—Can Reddy Stik non-corrosive Soldering Flux for Radio—Can Reddy Prest Sal Ammoniac, keeps tip clean—Can Reddy Rub Abrasive Tape. Complete directions. Ask your dealer. If not obtainable we will send direct, for a short time only, on receipt of price.

E. D. Fahlberg Mfg. Co., Madison, Wisconsin

JOBBERS AND DEALERS: Write or wire for attractive Reddy Hot proposition and samples. Display carton of 12.

PRICE, $1.50



E. D. FAHLBERG MFG. CO., Madison, Wisconsin
Send me prepaid one Reddy Hot Soldering Furnace for which I enclose $1.50. P. S. M.

My dealer's name is.....

Signed: Name.....

Address.....

Licensed by Independent Radio Manufacturers, Inc.
Reg. U.S. Pat. Off. NEUTRODYNE Reg. U.S. Pat. Off.
Patented March 27, 1923, Hazeltine Patent No. 1450080
Other Patents Pending

Ask your dealer to show you a Howard 4 and 5 Tube Neutrodyne Receiver

Write for folder and wiring diagram.

HOWARD MFG. CO.
467 East Ohio St., Chicago

The Home Workshop

How to Duplicate a Rare Table

(*Continued from page 89*)

The exact sizes of each piece are given in the following bill of materials, each item being lettered to correspond with the drawing on page 89. The dimensions are given in inches and the wood is either mahogany or walnut, except as otherwise noted.

A Center or main top, ⅞ by 22½ by 32, 1 required
B Table leaves, ⅞ by 13 by 32, 2 required
C Legs, 2⅛ by 2⅛ by 28⅛, 4 required
D Drawer rails, top, ⅞ by 1½ by 16, 2 required
E Drawer rails, bottom, ⅞ by 2⅛ by 16, 2 required
F Drawer fronts, ⅞ by 4 by 16, 2 required
G Drawer sides or ends, ½ by 4 by 13½, 4 required
H Drawer backs, ½ by 3⅜ by 15½, 2 required
I Drawer bottoms, ¼ by 13 by 15½, plywood, 2 required
J Side rails, top, ⅞ by 6½ by 25½, tenoned both ends (24½ between shoulders of tenons), 2 required
K Table braces, ⅞ by 6½ by 26½, 2 required (each piece will cut two braces)
L Guides, top of drawers, ⅞ by 1½ by 26⅜, whitewood, 2 required
M Guides, bottom of drawers, ⅞ by 2 by 25¼, whitewood, tenoned both ends (24¼ between shoulders of tenons), 2 required
N Guides, bottom runners, 5/16 by 1½ by 24, whitewood, 2 required
O Stretcher shelf, ⅝ by 7⅜ by 15⅛ (doweled to legs), 4 required
P Dowels, stock, ⅜ in. diameter
Q Table-leaf hinges, stock, 1¾ wide, brass, 6 required
R Top fasteners, stock ⅛ by ¾ by 1¼, iron 12 required
S Drawer pulls, stock, brass, 2 required
T Wood screws, iron.

Two methods of making the drawer joints are shown, but dovetails may be used, if the builder prefers.

The legs on the museum table, shown in the photograph, are round and tapered just above the foot and ornamented with reeding or flutes. This construction presents some difficulties and can be avoided by making the lower part of the legs square and tapered, with or without flutes, as preferred.

The finishing of a piece like this is of the utmost importance. Stain the wood, fill with paste filler, either walnut or mahogany color, apply a wash coat of thin shellac and then build up a smooth surface with coats of either shellac or varnish, well rubbed with pumice-stone and oil or water or a very fine grade of the so-called "wet" sandpaper. A dull shellac finish with the addition of several coats of furniture wax is one of the best for this piece.

The table could be made of whitewood and painted or enameled, the flutes being colored deeply for contrast. In that case knobs may be used instead of antique pulls.

Tightening Barrel Staves

STAVES of dry wooden barrels may be tightened easily with a tool made from a broken hoe, as illustrated. The offset allows the tool to be held away from the barrel at the upper end and this facilitates the work. The lower end has a small bevel so that it will not slip off the hoop.—I. S. THOMSON, Richmond, Utah.

A "tool" made from old hoe

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 31.

The Home Workshop

New Mirth-Provoking Card Game Made Quickly from Pictures

By Capt. E. Armitage McCann

NEW amusements are always in demand, both for big parties and quiet evenings at home. Here is a card game you can make yourself and spring on your friends as an entertaining novelty.

To make a set of cards for four or less players, six colorful pictures will be needed. If they are about 8 by 10 in., 10 cards about 2½ by 3½ in. will be required for each picture.

Arrange these 10 cards irregularly on the table and paste on them the picture in such a way that each will receive a portion of it, as illustrated. Then, with the corner of a razor blade, cut through the picture along the edge of each card. The set will fall apart with a piece of

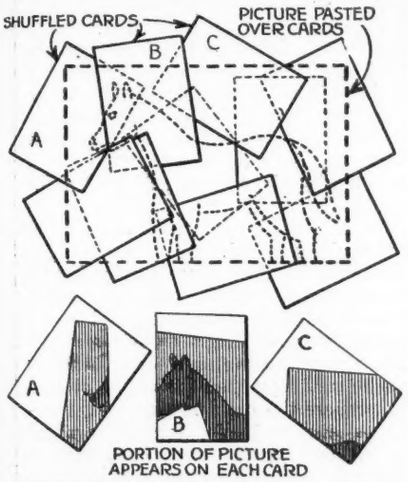


Diagram showing how a large picture is pasted over 10 cards, and three completed cards

picture on each card. Do this with the other five pictures, arranging the cards differently for each set.

The game is played by shuffling the cards and drawing and discarding them from the pack. The person who first forms a complete picture is the winner. Rules and a system of penalties and points can be formulated along any lines that seem desirable.

Use thin cards and paste the pictures down firmly. Sometimes the edges will need repasting after the cards are cut apart. The cards for the whole pack must be of the same size.

If there are to be more players, have more pictures. The game may be made amusingly educative by substituting maps or historical subjects.

New Workshop Features

AMONG the articles scheduled for early publication in the Home Workshop Department are: Salem Chest of Drawers Simplified for the Beginner in Woodwork, A Linen Cabinet Made from Packing-Cases, Reaning Chairs, A Quebec Coaster, Ammunition Press for Snowball Battles, Alarm Clock in Neat Case Resembles Costly Chronometer, and Nail and Hardware Cabinet for the Home Workshop.

EISEMANN
ELECTRICAL EQUIPMENT

Type 6-D Broadcast Receiver

Non-oscillating ~ Non-radiating

SPECIFICATIONS

Circuit: Two stages of tuned radio frequency amplification, detector and two stages of audio frequency amplification. Non-oscillating. Non-radiating. Astatic transformers used to minimize mutual induction.

Tubes: Five in all. Jacks provided for either five or four tube operation.

Batteries: Either storage or dry-cells.

Cables: Complete set supplied for "A" and "B" batteries.

Wavelengths: 200 to 600 meters, with uniform efficiency of reception.

Aerial: 75 to 125 feet, single wire.

Panel: Aluminum, with attractive crystal black finish. A perfect body capacity shield.

Dials: Sunken design. Shaped to fit the hand and permit a natural position in tuning.

Rheostats: Adequate resistance for all standard base commercial tubes.

Condensers: Single bearing, low leakage losses.

Sockets: Suspended on cushion springs which absorb vibrations.

Cabinet: Mahogany, with distinctive lines and high finish. Ample space provided for "B" batteries.

EISEMANN

THE real, intrinsic value of the 6-D Receiver can be fully appreciated only by making direct, side-by-side tests with other makes.

Such comparisons need not be confined to sets in the same price-class. The 6-D is the equal, in every detail, of many receivers priced $25, $50 and even $75 higher.

Performance of the highest order, strikingly attractive appearance and moderate price—all these elements of true worth are found in the 6-D.

You will note its clarity and the full, generous volume. You will also observe the unusual sharpness of tuning. And the finely carved, high finish mahogany cabinet will make a strong appeal.

Price $125.00 without accessories. For sale by reliable dealers. Ⓘ

EISEMANN · MAGNETO · CORPORATION
General Offices: 165 Broadway, New York
DETROIT · SAN FRANCISCO · CHICAGO

Ⓘ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 31.

Type BM Base Mounting $4.50

Jones

This is the MULTI-PLUG used by

THE STANDARD SET CONNECTOR

HOWARD, WORKRITE, ZENITH, MU-RAD and other leading set manufacturers.

INSTALL a Jones Multi-Plug and Cable on your set. A plug and cable is to the radio what the socket and cord is to the electric iron—a connector which is efficient, convenient, safe, and indispensable.

EFFICIENT because battery, antenna, and ground wires can be connected and disconnected by a single operation. Seven confusing operations reduced to a simple one. It assures perfect contact and is simple to connect.

CONVENIENT because it permits the moving of set anywhere without disconnecting wires. The eight foot cable allows batteries to be placed in basement or other suitable place.

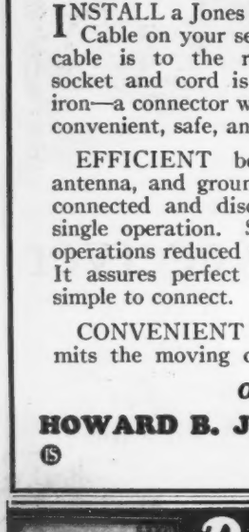
SAFE because no live ends are exposed and center pin is keyed so that wrong connections are impossible.

INDISPENSABLE. You will know why only after testing out this plug designed to meet the demand for an inexpensive yet practical and simple method of connecting batteries, antenna, and ground.

Order from your dealer or direct from

HOWARD B. JONES • • • 620 S. Canal St., Chicago

Write for illustrated folder.



Build a Super-Heterodyne Yourself and Save Money!

Experience the thrill of getting all the distant stations with a Super-Het built by yourself. It's easy with the RECEPTRAD KIT shown above. It contains all the essential parts with complete instructions. From your dealer or by mail for the remarkably low price of $53.50. Smaller kit containing only the most essential parts $33. Either set will operate a loudspeaker on an indoor, outdoor or loop aerial

RECEPTRAD

GREIFF DOUBLE SELECTOR **MULTIFLEX KIT**

The Perfect 4 Tube Circuit—Loop Operating

Uses four tubes. Two stages of radio frequency, a crystal detector and three stages of audio frequency. No station too distant to be brought in with good clear volume. Assembled by anyone in a few hours. Superior to a 5 tube Neutrodyne.

$29.50 Containing principal parts. $50 Including all parts.

FREE *Blue prints of wiring diagrams of both circuits. Just drop us a line giving your dealer's name and address.*

RADIO RECEPTOR CO.

59 BANK ST., NEW YORK.

RECEPTRAD PRODUCTS

The Home Workshop

A Folding Fireplace Screen

(*Continued from page 92*)

If you never have tried brazing, the making of a fire screen presents a good opportunity to learn, and it is easy. First get a small strip of silver solder and an ounce or two of common borax. The silver is inexpensive, as it is not real silver but an alloy of several metals so blended that their melting point is far below that of brass and yet, when cooled, the joint is so strong that it can be bent without breaking. After it has been melted and cooled, the solder has a yellowish tinge similar to brass. The solder will flow in the flame of a gasoline blowtorch when the metal which is to be joined is heated to bright red at the point of contact.

TO SOLDER, clamp the two pieces in contact so that they extend over a bench or in a convenient position. Sprinkle on some borax, turn on the flame, and when the brass at the joint has become bright red, rub the solder over it until it melts a little. Apply the flame directly until the liquid solder runs between the two pieces of metal; then shut off the gas. In a minute the solder will solidify and make a joint as good as the metal itself. Solder all four frames in this manner, taking care that the corners are carefully squared.

When all the frames are made, file off and emery polish the joints and any other places that need cleaning, and prick punch preparatory to drilling. It is necessary to measure only one frame for drilling, as it can be used as a templet for the others.

To prepare the brass mesh, cut it carefully to a size ⅛ in. less all around than the outside of the frames, that is 11¾ by 23¾ in. In order to prevent it from fraying out and to enable it to hold when riveted, a band of solder must be run around all sides. This is easily and quickly done by rubbing soldering paste or painting zinc chloride soldering fluid around the edge and then running a nearly red-hot soldering iron around the edge while holding a stick of solder against the hot iron. Lay the screen on a bench so that it overhangs and rub the hot iron along the upper side until two rows of squares are filled in evenly all the way around.

AS THE edge of the mesh will be visible on the inside of the completed fire screen, it should be bound with soft brass or copper ribbon .01 in. thick by 1 in. wide, soldered sufficiently to hold it on one side only and folded over, as indicated.

To rivet on the screen, lay it under the drilled frames and mark the proper place for the holes with a gimlet or other sharp tool; then force holes with it through the brass-bound edge. File down the rough edge on the side where the gimlet breaks through. Ordinary auto brake band brass rivets should be used, as these are split, require no washers, and can be headed over quickly.

When all the screens have been riveted on, the sections should be joined by riveting on the hinges.

(*Continued on page 119*)

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 31.

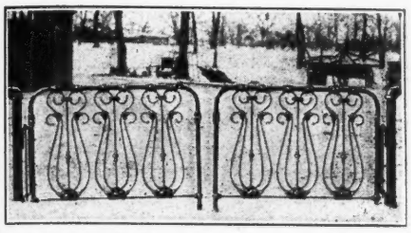
The Home Workshop

Old Iron Bedstead Converted into an Ornamental Gate

THE two ends of an iron bedstead can be used effectively as gates in connection with either a wire or an iron fence.

An old iron bedstead can be had for next to nothing at almost any junk dealer's or second-hand store. The ends shown were bought for 50 cents each.

The head end must be cut down so that it equals in height the foot end. A hack-saw will do this, while the castings into



Gates made from iron bedstead ends purchased from a junkman for 50 cents each

which the bed rails fit can be knocked off with a hammer.

A heavy piece of band iron, from 18 in. to 2 ft. long, as necessary, is bent so that 1 in. extends at right angles at either end. Into each of these short ends a hole is drilled. One of these pieces is bolted to each bed end. Onto the gateposts are bolted or welded short pieces of iron with ends similarly bent and drilled and so spaced that the two halves of each hinge will fit properly. An iron rod extending from top to bottom holds each pair of the hinges together.

To add strength to the gates a sliding shoe of curved iron is provided for each half, fastened by means of a round piece of iron extending into the hollow of each free leg. To lock such a gate a number of devices will suggest themselves besides the one illustrated.—C. L. MELLER.

VARNISHED woodwork that has been neglected can be given much of its old time luster provided it is not stained by the atmosphere. Simply apply furniture wax, rub it in well and polish vigorously.

When commercial size is not obtainable readily, plastered walls and ceilings that are to be painted with oil paints may be sized with carpenter's glue diluted with a large quantity of water.

A Folding Fireplace Screen

(*Continued from page 118*)

To give an art brass finish and remove any discolorations caused by soldering flux or heat, scrub the screen all over with a wet brush which has been dipped in powdered pumice. A coat of thin, colorless lacquer will insure the permanency of the bright finish if the screen does not come into actual contact with the fire.

If something less plain than a straight top is desired, such as a curved or Gothic top, it will be necessary to cut out the tops from sheet brass with a cold chisel and then file them to the proper shape. A sheet-brass wreath sometimes is added to give a finishing touch.

ALL-AMERICAN

Solves Every Gift Problem

If He Has a Radio Set Already—

It can be made a better one by installing genuine ALL-AMERICAN Audio Transformers. Two of these instruments, fitted into any set not already equipped with them, will give the receiver greater loud speaker volume with remarkable purity of tone. ALL-AMERICAN Transformers are so designed that they amplify fundamentals and harmonics equally, throughout practically the entire audible range. Hence, voice and tones are reproduced *faithfully*.

Give him ALL-AMERICANS, the Audio Transformers which, through sheer merit, have become the largest selling transformers in the world. **3 to 1 Ratio, $4.50; 5 to 1 Ratio, $4.75; 10 to 1 Ratio, $4.75.**

If He Needs a High Grade Receiver—

Give him ALL-AMERICAN Super-Fine Parts, and he can build an intermediate-frequency receiver embodying all the most advanced features known in Radio. His set will be the envy of "distance" fans, as well as of his musical friends.

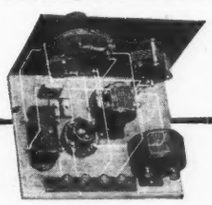
Super-Fine Parts are easily installed. No critical adjustments are necessary. Operation is smooth and flawless. And every part is ALL-AMERICAN—ask any Fan what that means in Radio! Sets built with Super-Fine Parts are unsurpassed for selectivity, range, volume, and tone quality. They represent in a very real sense *the ultimate* in radio broadcast reception. **Price, $26.00.**

Ⓢ

ALL-AMAX JUNIOR

The ideal gift for the youthful beginner in Radio. A one-tube reflex already mounted on panel and baseboard. Photographic instructions make wiring the easy task of one evening.

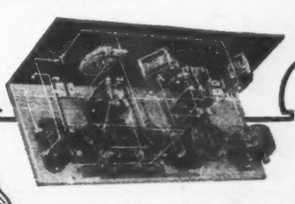
Price, complete (semi-finished) $22.00



ALL-AMAX SENIOR

The Senior is a complete receiver of the highest type—a three-tube reflex with great range and selectivity. It comes completely assembled with full directions for wiring.

Price, complete (semi-finished) $42.00



The Radio Key Book
"You'll Be Surprised" Sent for 10 cents, coin or stamps.

ALL-AMERICAN TRADE MARK

RAULAND MFG. CO.
Pioneers in the Industry
2668 Coyne St., Chicago

Largest Selling Transformers in the World

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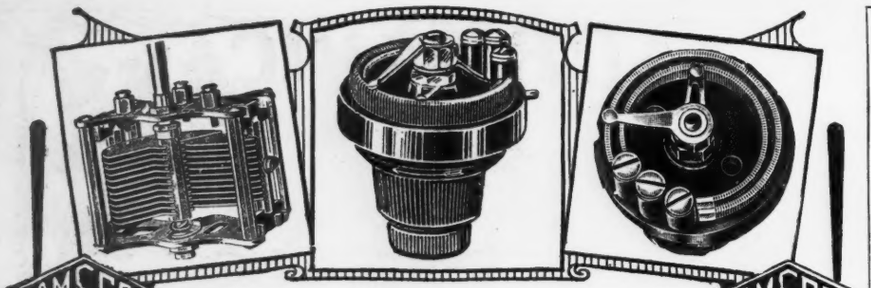


Consider Carefully

The parts you select to build your set. Know beforehand that the results will be up to expectations. Particular set builders use only Amsco apparatus. They are built and designed by men who really understand radio and are guaranteed to function properly. Comparison proves their superiority and extraordinary value.

SEE THESE AMSCO PRODUCTS AT YOUR DEALER'S

AMSCO LOW LOSS CONDENSER. A laboratory instrument for perfection in set building.
AMSCO DUBLWUNDR. Combination rheostat and potentiometer.
AMSCO DOUBLE RHEOSTAT. Does the work of 2 old style rheostats. Saves panel space and wiring.

Write for interesting literature.

AMSCO PRODUCTS, Inc.,
Broome & Lafayette Sts., New York

So Easy Now, to Know that You Can Play

BY measuring your natural musical ability, this famous, free, new Holton Talent-Test tells you how easy it may be for you to win success on this easiest-to-learn of all saxophones.

In just a few interesting minutes any unsuspected gift is brought to view. You determine, to your own satisfaction, how near you really are to new and endless hours of pleasure, social eminence, and even increased income if you choose. Thousands have done so. In fairness to yourself, accept this opportunity.

Your request for copy of this booklet brings you Appointment Card entitling you to the Talent-Test in the privacy of any Holton dealer's studio, or in your own home, with the aid of our copyrighted phonograph record, on which the Talent-Test is recorded.

FREE BOOK —tells how test is given.

FRANK HOLTON & CO.
Elkhorn, Wis.
America's Greatest Band Instruments

Holton
New Revelation
SAXOPHONE

Frank Holton & Co., Elkhorn, Wis.

Without obligation, I want to determine my talent for the easy-to-learn Holton New Revelation Saxophone. (Check if interested in any other instrument):

Cornet ( ) Trombone ( ) Baritone ( ) Trumpet ( )

Name_____

Street Address _____

Town State

Must Men Fear 40?

MEDICAL authorities agree that 65%, or nearly two-thirds, of all men past middle age, are afflicted with a disorder of the prostate gland. Here is the known cause for many of the ailments commonly ascribed to declining years—including aches in back, feet and legs, frequent nightly risings, sciatic pains, nervousness and lack of vitality. But now, science knows that thousands suffer needlessly.

For a member of the American Association for the Advancement of Science has discovered a remarkable new drugless hygeine that usually restores the prostate gland to its normal functioning. Already it has been used by more than 15,000 men—Doctors, Statesmen, Teachers, Bankers, Lawyers, men in every walk of life—with amazing results.

FREE BOOK

If you will mail the coupon below you will get, in plain wrapper, a free copy of an interesting book describing this new method. It contains facts every man should know. But send immediately, for the edition of this book is limited; address

THE ELECTRO THERMAL COMPANY
4041 Main Street. Steubenville, Ohio

Please send me Free, and without obligation, a copy of your booklet, "Why Many Men Are Old at 40." Mail in plain wrapper.

Name_____

Address_____

City_____ State_____

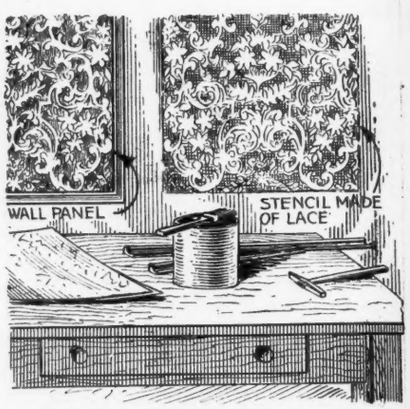
Western Office—Dept. 40F, 711 Van Nuys Bldg., Los Angeles, Cal.

The Home Workshop

Old Lace Forms Stencil for Decorative Wall Panels

THE latest development in the art of stenciling is to use a piece of old lace in place of the usual stencils cut from stencil board. The lace gives exceptionally delicate results when properly used, especially for the wall panels now popular.

The lace is prepared by giving it a coat of shellac to stiffen it. It is fastened



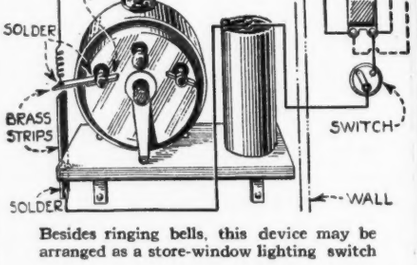
The shellacked lace gives more delicate effects than an ordinary knife-cut stencil

firmly against the wall and the color is applied with a stiff stencil brush in the usual way, except that great care must be taken to prevent the design from becoming blurred. It is advisable to practise a little before trying the method on a finished wall.

When dry, the panels are framed with panel molding.

Alarm Clock Rings Electric Bells in Separate Rooms

IN ORDER to use one alarm clock for two separate bedrooms and at the same time eliminate the noisy ticking that so annoys light sleepers, I hooked the clock to an electric call bell system as shown.



Besides ringing bells, this device may be arranged as a store-window lighting switch

When the alarm goes off, a piece of No. 16 gage brass soldered to the alarm key revolves and strikes another strip screwed to the wooden baseboard. This closes an ordinary electric-bell circuit and a bell rings in each bedroom.

One or two switches may be installed to control the bells. The clock should be fastened to the base.—W. T. M.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 31.

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

A SOLUTION for re-inking typewriter ribbons consists of the "lead" of an indelible pencil dissolved in a solution of equal parts of pure grain alcohol and glycerine. Apply to the ribbon with a semi-stiff brush.

Ink for labels may be made of equal parts of pyrogallic acid (the photographer's pyro, not hypo) and green vitriol (iron sulphate), dissolved in water. The addition of a little gum arabic or tragacanth will prevent any tendency to spread. It is best to varnish the label when marked, using the varnish mentioned last November in this column.

A simple ink for writing on blueprints is made of ¼ teaspoon of washing soda (soda carbonate) in 4 tablespoons of water, thickened with gum arabic or gum tragacanth.

Splitting indelible pencil (above) to make typewriter-ribbon ink

Dissolving "lead" (at left) and adding gum (below)

"Sympathetic" inks are those that become visible only when they have been treated with light, heat, or some chemical. The juice of lemon, orange, or onion, when used as an ink, is invisible, and the characters are developed by heat, applied with a flat-iron. Writings with ferric sulphate are developed by a strong solution of tea or tannin. When paraffin is diluted with benzol and used as an ink, the writing may be read by dusting it with charcoal or smoking it with a candle flame.

An etching ink for steel or iron tools consists of about ½ lb. of ordinary rosin, melted, to which is added 1 tablespoon of lard oil—a lubricating oil expressed from lard—and 2 tablespoons of turpentine. One or two tablespoons of lampblack may be added, but this is not absolutely necessary. When this mixture or ink is cold, it should be thick. Spread a little on a stamping pad and ink the rubber stamp. Press the stamp carefully on the tool to be etched, which must be perfectly clean. Make a border of putty or wax around the design or lettering and pour into this the etching fluid described in this column last August.

The secret of easy charging

MAYBE you think the storage battery a difficult proposition. Charging is what used to cause trouble—until we developed

The New Silent GOLD SEAL HOMCHARGER

Now charging is as simple as ABC. Here's the HOMCHARGER way: Slip two spring clips over the battery terminals, and screw a plug into any lamp socket. That's all. Go right on using your set, if you want. You can even sleep in the same room with the HOMCHARGER, it's so quiet.

So get a good storage battery, the new silent GOLD SEAL HOMCHARGER, and enjoy radio at its best.

Handsome: Finished in mahogany-red and gold. Non-scratching rubber feet. Absolutely safe, absolutely certain, care-free. Unqualifiedly guaranteed.

FREE! *Ask your dealer or send direct for a copy of the booklet, "The Secret of Distance and Volume in Radio," containing valuable information as well as complete details of the new silent* GOLD SEAL HOMCHARGER.

THE AUTOMATIC ELECTRICAL DEVICES CO.
Largest manufacturers of Vibrating Rectifiers in the World
131 West Third Street, Cincinnati, Ohio
Under the same management as the Kodel Manufacturing Company

Ⓢ

14 GOLD SEAL HOMCHARGER features

1—Simple; needs no care.
2—Efficient; costs about 5c to charge the average battery, much less than bulb or liquid types of charger.
3—Quick; brings battery up to full charge overnight.
4—Tapers charge; cannot injure the battery.
5—Clean; no bulbs to break, no liquids to spill or produce fumes.
6—Dependable; adjusted and sealed at factory.
7—Lasts forever; only one moving part, the Tungsten contact, which can be replaced at $1 after many thousands of hours of use.
8—Fool-proof; charges automatically, no matter which clip is attached to which battery terminal.
9—Safe; approved by Fire Insurance Underwriters. No danger of shock or fire.
10—Beautiful; sturdy metal case finished in mahogany-red and gold.
11—Universal; made in types for all voltages of alternating and direct current. Charges all radio "A" and "B" batteries, and automobile batteries.
12—Quiet; its faint hum cannot be heard in next room.
13—Unqualifiedly guaranteed.
14—Popular price; sold everywhere for $18.50, in Canada $26. Complete, no extras to buy.

Ⓢ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 31.

So Many More —Count 'em!

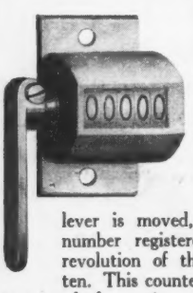
When you start to count the product of your machine, you start to get *more product.*

You mean not only to get a count, but to *increase* the count—and be able to check-up the increase.

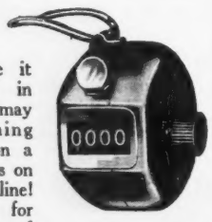
An initial record of so-many pieces per hour soon leads to so-many *more,* for the count points the way. It shows what methods, what changes in mechanism show *GAINS*—by your

Veeder COUNTER

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price $2.00. (*Cut nearly full size.*) Small *Revolution* Counter, also $2.00.



The Hand Tally illustrated below is used for counting anything from number of people in a public place, to number of packages in an inventory. In the factory or store it counts *stock;* in the "open" it may count anything from cattle on a ranch, to poles on a telephone line! Registers one for each pressure of the thumb lever; counts up to 10,000, then repeats. Can be set back to zero from any figure by turning knob once round. Size, exclusive of finger ring, 2 inches greatest diameter. Price, $5.00.



Write us about that counting problem of yours—it's probably solved in the 80-page Veeder booklet; copy free

The Veeder Mfg. Co.
44 Sargeant St. Hartford, Conn.

The Shipshape Home

Leaking Faucets

COMMON water faucets found in the home may be one of two types — compression or Fuller. The first type makes use of the screw threads for pressure in closing, while the second depends on the leverage of the handle and the attached rods.

If a faucet leaks when it is closed tightly, the trouble is with the rubber (or fiber) washer located in the main passage. This washer should be replaced immediately, since a continuous dripping of water will add materially to the water bill, and, what is probably more serious, make stained spots on basins, sinks, and tubs through the mineral deposits from the water. These stains become evident in a short time and usually are hard to remove.

Using rag to prevent wrench marks on faucet

The other type of leak commonly encountered is one that allows the water to spurt out around the valve stem while the water is turned on and sometimes sprays a part of the wall or furniture or wets the operator. It is seldom, however, that a leak around the valve stem cannot be stopped by tightening the cap or packing nut.

Washers for both types of faucets usually are available at a 10-cent store and always at a hardware shop. The expense is so small that one can well afford to keep one or two washers in store for each kind of faucet, just as extra fuses are provided for the fuse box.

To repair a compression faucet:

1. Shut off the water at the valve on the main line leading into the house. This valve usually is located near the water meter. Every housekeeper should know where it is and how to operate it in case of serious faucet troubles or broken or frozen pipes.

2. Open the faucet and let the water drain out.

3. Loosen the cap (packing nut) with a monkey-wrench or large automobile wrench. To prevent scarring the finish, put a rag around the nut before applying the wrench.

4. Unscrew the valve stem by turning the handle to the left until it is removed entirely. This is all the disassembling necessary. Now loosen the screw holding the disk washer.

If the head of the screw has corroded to such an extent that it breaks, cut out the washer first and turn the screw with a pair of pliers. Fasten a new washer in the recess from which the old has been removed, trimming it to fit, if necessary. A rubber, fiber, or leather washer may be used. A hard washer is preferred for hot water and a soft one for cold. Examine the seat for the washer and make sure that it has not become rough where the washer was worn away. If it has, it should be smoothed. This often can be done with a screwdriver or the square end of a narrow flat file. Some faucets have seats that can be replaced with new ones.

Removing nut on a Fuller faucet with an ordinary pair of pliers

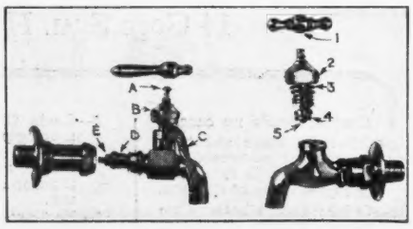
Put the valve back in place and tighten the packing nut. If the faucet turns too hard, the packing nut has been made too tight.

To repair a leaky Fuller faucet:

1. Shut off the water at the main valve and drain the faucet.

2. Disconnect the faucet at the middle joint. This is necessary because the washer is not located on the valve stem and is not accessible from the top of the faucet. If there is no middle joint, the faucet is of the compression type; this is the most obvious distinction between the two kinds.

3. Replace the rubber ball or washer by removing the small nut. Put in new rubber and replace the nut. Reassemble the faucet after having examined it for other possible troubles.—E. E. ERICSON.



Fuller faucet (at left): *A*, handle screw; *B*, packing nut; *C*, cotton packing, which seldom needs renewing; *D*, rubber ball, which causes a leak when worn; *E*, ball-retaining nut. Compression faucet (at right): 1, handle; 2, cap or packing nut; 3, packing-nut washer, which rarely gives trouble; 4, main washer, responsible for most faucet leaks; 5, washer-retaining screw

IS This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 31.

The Shipshape Home

Puttying Windows

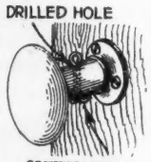
IN REPLACING a broken pane of glass, the home worker usually has little trouble except in making the putty look straight and neat. This can be accomplished by pushing a piece of cardboard against the edge of the putty, as shown,

to straighten it. One corner of the cardboard is mitered and used to true up the corners of the putty.

If linseed oil is brushed on wood surfaces that are to be puttied, the putty will not readily dry up and fall off.—WARREN SCHOLL, Saint Ignace, Mich.

Repairing Door-Knobs

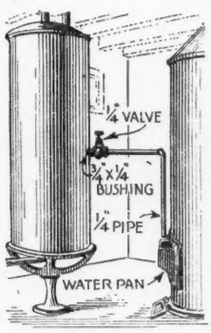
WHEN a door-knob was pulled off recently in my home, I found that the small setscrew had broken in two. Not having a screw of the right size available at the time, I drilled right through the shank of the knob, replaced the knob on the spindle and passed a cotter-pin through the holes, as shown. The ends of the pin were bent round on the outside. The repair was inconspicuous and there was no danger of the knob's coming off again.—D. R. V. H.



Water Supply for Furnace

TO SHORTEN the daily job of filling the water pan of my hot-air furnace, I have installed a supply pipe, as illustrated. This was done by removing the ¾-in. plug in the side of the hot-water tank, which stands near the furnace, and substituting a ¾ by ¼ in. bushing. A short ¼-in. nipple was screwed into the bushing, followed by a globe valve and 2 lengths of ¼-in. pipe connected by an ell. The end of the pipe was brought down to about 3 in. above the pan.

This additional piping makes it possible to fill the water pan in a few seconds.—G. M.



Connections for filling vapor pan

This Amazing Five Tube Set has Only

One Dial to Tune

Just **ONE** Dial to turn to get coast to coast range.
Just **ONE** Dial to adjust to get perfect tone reception.
Just **ONE** Dial to tune to get the utmost in selectivity.

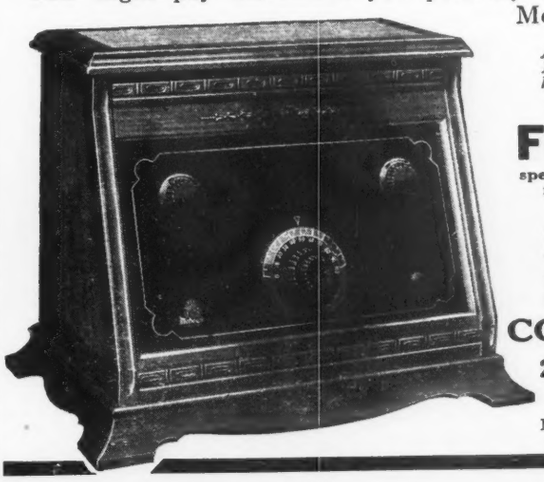
HERE—at last—is a five tube tuned radio frequency Receiver with a distinctive simplicity of design. It is a beautiful set, and with its simple ONE Dial Control it will do anything any other five tube set will do,—and will do it with one setting of the dial!

Tunes Out Local Stations—Gets Distance Easy

Just **ONE** Dial to turn on the MOHAWK, and as you turn it you tune in station after station covering the complete range of radiocasting wave lengths. It cuts out the nearby stations with ease and brings in the distant ones clear and distinct. You can operate it with an aerial of any length to give satisfactory results under varying conditions.

Ⓢ The Mohawk
5-Tube Receiver

Built in a distinctive period type walnut cabinet, it will instantly appeal to the artistic taste of the most critical. Yet its beauty is not "only skin deep." The quality goes clear through.
Don't fail to see the MOHAWK—hear it, and try it, before you buy. You might pay more—but you probably wont if you try the Mohawk first.



Ask your dealer about the new MOHAWK. If he does not have it, accept no substitute. Write us.

FREE Handsome descriptive folder tells all. Prices, specifications and remarkable results. FREE on request.

MOHAWK ELECTRIC CORPORATION
2236 Diversey Blvd.
CHICAGO, ILL.
Dealers and Distributors Wanted Everywhere

Tested and Listed as Standard by Underwriters' Laboratories

U. S. Patent 1,495,582

The FANSTEEL **Balkite** *Battery Charger*

does not create disturbances in your set or your neighbor's

The Balkite Battery Charger is entirely noiseless. It can be used while the radio set is in use. It has no moving parts, vibrators or bulbs, and has nothing to break, adjust or get out of order. It is simple and unfailing in operation. It cannot discharge, short-circuit or damage the battery by overcharging. Besides charging "A" batteries it will also charge "B" batteries of the lead type in multiples of 6 cells. *Sold by all leading radio dealers.*

PRICE **$19.50**

$20 West of Rockies, $27.50 in Canada

Ⓑ

Manufactured by FANSTEEL PRODUCTS CO., Inc., North Chicago, Ill.

Don't Blame Your Set!

If the batteries run down, you're lucky to get anything but "sounds."

APCO Battery Charger keeps radio batteries *alive*. Works noiselessly, efficiently, surely, fully charging any radio battery over-night for a few cents. 7½ ampere capacity. Pays for itself in six months. Guaranteed one year.

Write for circular and dealer's name

APCO MFG. CO.
Baker Street, Providence, R. I.

APCO BATTERY CHARGERS Ⓑ
for "A" and "B" Batteries

How to Become a Successful Electrician

By Prof. T. O'Conor Sloane. The studies to be followed, methods of work, field of operation and the requirements of the successful electrician are pointed out and fully explained. 202 pages. Price, $1.50.

POPULAR SCIENCE MONTHLY
250 Fourth Avenue NEW YORK

Tool Cases

for Machinists, Carpenters and Tool Makers; none better; thirty styles. Quartered oak and metal covered. Ask for booklet.

"Built for Service"
The Pilliod Lumber Co., Swanton, Ohio

BARGAIN CATALOG *Yours* **FREE!** 100 Pages!

Just send your name

Get it now!

Crammed full of information and offers of all kinds of complete **RADIO SETS, Parts and Accessories**

Only $21.95 for 1-tube outfit, receiver parts unassembled; often receives over 1,000 miles. **Only $53.75** for 2-tube outfit, receiver assembled; often receives over 1,000 miles on loud speaker. **Only $85.00** for 5-tube Neutrodyne outfit, receiver parts unassembled; has received England. These prices include all accessories, aerial, etc.—everything needed for receiving on head phones. Also, **Crosley receivers, 10% off.** 25 other popular sets away down. **It's easy to do business with us,** for this is "The Radio House of Friendly Service." All goods offered subject to examination and approval. No money in advance. Quick shipment. We pay transportation anywhere in U. S. *Satisfaction or money back.* Your questions answered free. **Get this wonderful catalog**—you need it—**write today!** (And will you be so kind as to add the names of several friends you believe will soon want radio goods?. Thank you!)

Very interesting!

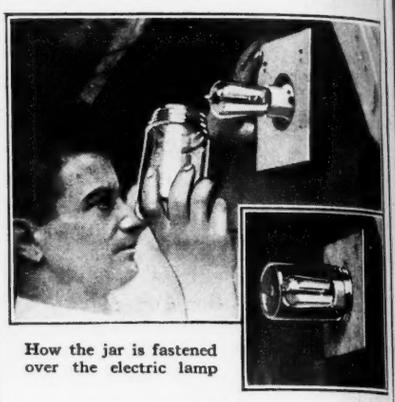
LIBERTY MAIL ORDER HOUSE
Dept. A-164, 106 Liberty St., N.Y.C.

The Home Workshop

Mason Jar Is Cheap Protector for Exposed Electric Light

THE simplest and cheapest way to protect an electric light placed in an exposed situation or where it might be broken is to cover it with a Mason jar, as shown below.

A hole is bored with an expansive bit in a square block of wood large enough to take the cap of the jar. This is pressed in



How the jar is fastened over the electric lamp

tightly and held with a few small nails. Inside the cap is placed a thin block, to which the keyless porcelain socket is fastened.

Holes are drilled through the three parts to take the electric wires, and the whole is fastened in place with nails or screws. The wires are connected, the bulb inserted, and the Mason jar screwed in place as a cover.

A MATCH, that has been scraped, partly split, pointed, and moistened, makes a good pair of tweezers for removing particles, and expecially turned eyelashes, from the eye.

Dressing Up Your Radio Receiver

(*Continued from page 90*)

and wherever a wire joined another wire, we used solder tees. Although it required searching around to buy them, we obtained nickel-plated soldering lugs and tees to match the bus bar.

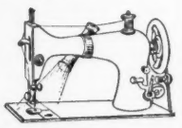
Instead of using a piece of packing case for a baseboard, we used a highly finished piece of clear wood. Instead of brass brackets, we made brackets from an old aluminum coffee-pot and polished them to look like nickel plate.

After the set was wired, we tested it, "shot all the trouble," and then put it in our cabinet. We drilled the rear of the cabinet and set in "key socket bushings" to lead our battery and aerial wires through, and screwed on the panel with nickel-plated oval-headed countersunk screws (½ in., No. 5), and didn't let the screwdriver slip once!

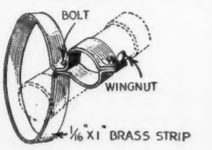
Dad's set is now three months old. We are up in the attic every night with the "superhet," listening to the distant stations, but we have a little secret. One night after a dance we tried out Dad's set for distance, and would you believe it—we had a station that our "superhet" gets about once a year. So good workmanship counts in efficiency as well as in looks.

The Home Workshop

Flashlight on Sewing-Machine Aids in Threading Needle



AFTER wearing out my patience in threading the needle of my sewing-machine, I attached a flashlight to the arm of the machine head, as illustrated. The clamp is a strap of 1/16-in. brass, 1 in. wide, held with a pair of bolts and wingnuts. The light is in the right position to throw the needle into silhouette, thus illuminating its elusive eye, so that threading it becomes easy.—PHILIPPE A. JUDD, Portsmouth, Ohio.

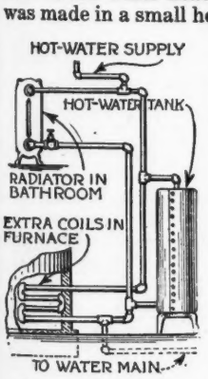


Auto Tire Improves Sawbuck

SECTIONS of an old tire casing fitted over the horns of a sawbuck are a surprising aid in holding sticks of cordwood in place. The rubber should be nailed on as shown above, so that the slight bulge of the tread is facing inward.—C. L. MELLER, Fargo, N. D.

Radiator Furnishes Heat and Increases Hot-Water Supply

TO PROVIDE additional heat in the bathroom and at the same time increase the amount of hot water available for washing purposes, an ingenious extension of the water-heating system recently was made in a small house in Washington, D. C.



Connections for the auxiliary radiator

A hot-water radiator was placed in the bathroom and connected as indicated with the furnace coils so that it serves as an auxiliary hot-water tank. The coils in the furnace were increased in size correspondingly and a valve was provided for cutting off the heat when not required. Care was taken not to place the valve where it would cut off the supply from the water main to the heating coils and regular tank.—G. A. L.

The GREATER Neutrodyne EAGLE Balanced Receiver

New Model B
5 Tubes
$175

Good Reasons For Buying The New Model B Eagle Receiver

GUARANTEE

The warrantee that accompanies every Eagle Receiver fully protects you.

Exclusive Eagle Instruments

Multiple (filament control) switch, ball-bearing, die-cast condensers, revolving resistor element rheostat—refinements of the neutrodyne receiver found *only* in the *New Model B Eagle*. Cannot be purchased except as incorporated in the Eagle.

BALANCE

the perfect balance of tube capacities, which is the secret of neutrodyne efficiency. Assured by expert workmanship and repeated checking tests before each set leaves the factory.

MODEL BS
A New Eagle Artistic Console Cabinet
Price $100

An artistic Console cabinet for the EAGLE in American Walnut or Mahogany, with fume-proof compartments for battery and charger.

A Happier New Year

My dear Boy:

Only your wonderful thoughtfulness could have found just the very gift I wanted—the New Eagle Receiver. When folks asked me this year "Was Santa Claus good to you?" I told them I had someone who was better to me than even Santa Claus.

I was a little afraid that radio might prove too complicated for me but the Eagle is so easy to operate as my phonograph. John made up a log for me and now all I do, is decide on the program I want to hear and turn the dials to the numbers for that station. No more loneliness, long evenings, dull times. My Eagle keeps me entertained.

John says its the best radio set money could buy, to which I replied "Of course, didn't Bob select it for me." Now John is going to get a new Model B Eagle. Says its just the set he's been waiting for.

I appreciate this wonderful gift more than I can tell you.

Your affectionate Mother.

Write for Literature

Licensed by Radio Manufacturers' Ass'n
NEUTRODYNE
Pat. March 27, 1923 and April 1, 1924; Pending Pats. Nos. 1,450,080 and 1,488,259
Other Patents Pending

EAGLE RADIO CO.
26 Boyden Place NEWARK, N. J.

HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years*. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

Check and mail the coupon NOW for full particulars and Free Bulletin.

American School
Dept. H-175
Drexel Ave. and 58th St., Chicago

American School
Dept. H-175 Drexel Ave. & 58th St., Chicago
Send me full information on the subject checked and how you will help me win success.

.....Architect	.....Business Law
.....Building Contractor	.....Lawyer
.....Automobile Engineer	.....Machine Shop Practice
.....Automobile Repairman	.....Mechanical Engineer
.....Civil Engineer	.....Shop Superintendent
.....Structural Engineer	.....Employment Manager
.....Business Manager	.....Steam Engineer
.....Cert. Public Accountant	.....Foremanship
.....Accountant and Auditor	.....Sanitary Engineer
.....Bookkeeper	.....Surveyor (& Mapping)
.....Draftsman and Designer	.....Telephone Engineer
.....Electrical Engineer	.....Telegraph Engineer
.....Electric Light & Power	.....High School Graduate
.....General Education	.....Wireless Radio
.....Vocational Guidance	.....Undecided

Name .....

Address .....

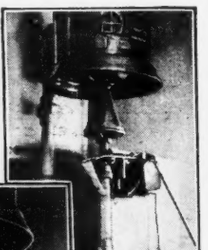
The Home Workshop

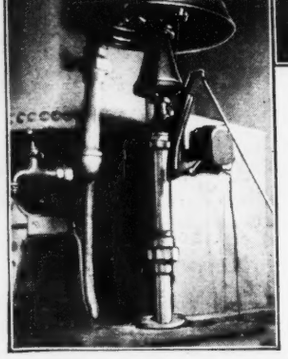
Turning Off a Water-Heater from a Distance

By W. W. Michaux

BY PRESSING a button in the bathroom I can turn off the gas water-heater in my kitchen. The remote control system by which this is accomplished was installed for $2. It saves many steps and much gas, and would be even more useful in a house where the water-heater is located in the cellar.

To a board under the water-heater I attached an ordinary door-bell with the gong removed. This I connected with a pushbutton in the bathroom and with another in a convenient position in the kitchen, as well as with the transformer that supplies the current for the regular door-bell system. Dry cells, of course, could be used in place of the transformer and would give equally good results.





The electric control in the "on" position (at left). Ringing the bell causes the vibrating clapper to strike a spring catch and free the lever, which is closed by the spring (above)

I bent one end of a 6-in. length of flat iron at right angles, beveled it off, and filed a small notch in it. A coilspring was fastened to the other end and the piece was fastened to the gas cut-off lever, as shown above.

The coilspring holds the lever in the cut-off position until it is turned on by hand, when the notch in the beveled end of the iron strip is hooked in a small flat spring attached to the bell board. When sufficient water has been heated, the button in either the bathroom or the kitchen is pressed. This causes the clapper of the bell to vibrate and hit the flat spring, jarring it sufficiently to release the notch in the flat iron strip. Thereupon the spring pulls the lever to the off position, shutting off the gas.

Broken Type Cleans Bottles

TO CLEAN dirty bottles when other methods fail, obtain from a print shop a small quantity of old type. Break it up into small pieces, place them in the bottle to be cleaned with some hot water, or strong lye, and shake well. The sharp edges of the type will loosen hard and stubborn deposits more quickly than lead shot and may be used over and over again.—H. L. W.

WET CELLARS MADE DRY *from the Inside!*

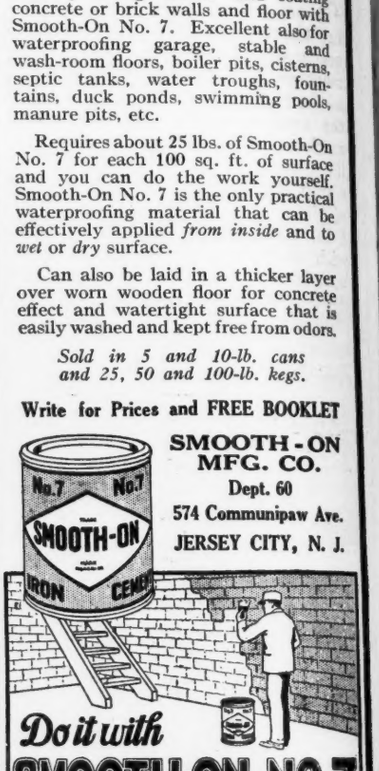
MAKE and keep your cellar dry by filling cracks and coating concrete or brick walls and floor with Smooth-On No. 7. Excellent also for waterproofing garage, stable and wash-room floors, boiler pits, cisterns, septic tanks, water troughs, fountains, duck ponds, swimming pools, manure pits, etc.

Requires about 25 lbs. of Smooth-On No. 7 for each 100 sq. ft. of surface and you can do the work yourself. Smooth-On No. 7 is the only practical waterproofing material that can be effectively applied *from inside* and to *wet* or *dry* surface.

Can also be laid in a thicker layer over worn wooden floor for concrete effect and watertight surface that is easily washed and kept free from odors.

Sold in 5 and 10-lb. cans and 25, 50 and 100-lb. kegs.

Write for Prices and FREE BOOKLET



SMOOTH-ON MFG. CO.
Dept. 60
574 Communipaw Ave.
JERSEY CITY, N. J.

FREE

To Each Purchaser of a World Battery

A 24-Volt "B" Storage Battery positively given FREE with each purchase of a WORLD "A" Storage Battery. The WORLD Battery is famous for its guaranteed quality and service. Backed by years of Successful Manufacture and Thousands of Satisfied Users. You save 50%.

Prices That Save and Satisfy

Auto Batteries		Radio Batteries	
6-Volt, 11 Plate	$12.25	6-Volt, 100 Amps.	12.50
6-Volt, 13 Plate	14.25	6-Volt, 120 Amps.	14.50
12-Volt, 7 Plate	17.00	6-Volt, 140 Amps.	16.00

Shipment Express C. O. D. subject to examination. 5 per cent discount for cash in full with order.

2-Yr. Guarantee Bond in Writing With Each World Storage Battery

proves satisfactory World performance. Mail this ad with your name and address — we will ship battery day order is received; and give you your choice of "B" Storage Battery or a handsome nickle finish Auto Spotlite, **FREE. Write TODAY.**

WORLD BATTERY COMPANY
1219 So. Wabash Ave. Dept. 7 CHICAGO, ILL.

This FREE "B" Storage Battery takes the place of dry cell "B" batteries. Can be recharged and will last indefinitely. To be sold retail for $6.00. It is the only battery of its kind equipped with solid rubber case—and insurance against acid and leakage. Take advantage of this remarkable introductory offer NOW. (To those who prefer it, we will send FREE a handsome nickel finish Auto Spotlite, instead of the "B" Battery. Be sure to specify which is wanted.)

GIVEN FREE
To introduce this new and superior World "B" Storage Battery to the Public

(IS) This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 31.

The Home Workshop

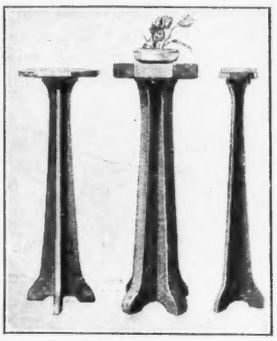
Sturdy Pedestals and Smoking Stand Built on Craft Lines

By J. T. Garver

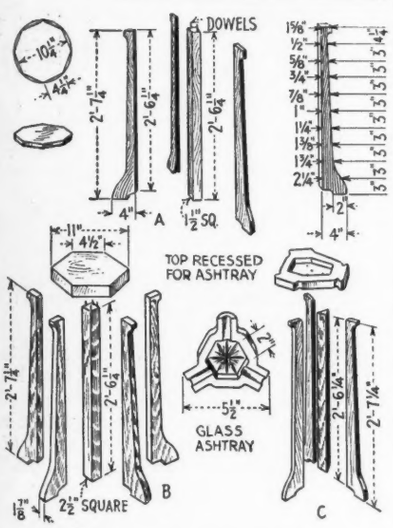
THE characteristic sturdiness of these Dutch craft pedestals and smoking stand will appeal to the man or boy who likes to build furniture.

While oak or walnut are always preferable, the inexpensive and easily obtained soft woods, such as pine, poplar or gum, if well seasoned, will answer well in the construction of these pieces. The heavy center pedestal in the photograph below is made entirely of chestnut.

The parts needed for pedestal *A* are: 4 uprights, ¾ in. thick, 4 in. wide and



Two types of pedestals, one heavier than the other, and a smoking stand (at right), and dimensioned details showing the simplicity of construction (below)



2 ft. 7¼ in. long; 1 standard, 1½ in. square and 2 ft. 6¼ in. long; 1 eight-sided top piece, laid out in a 11½-in. circle, ¾ in. thick; dowels, finishing nails, glue and screws.

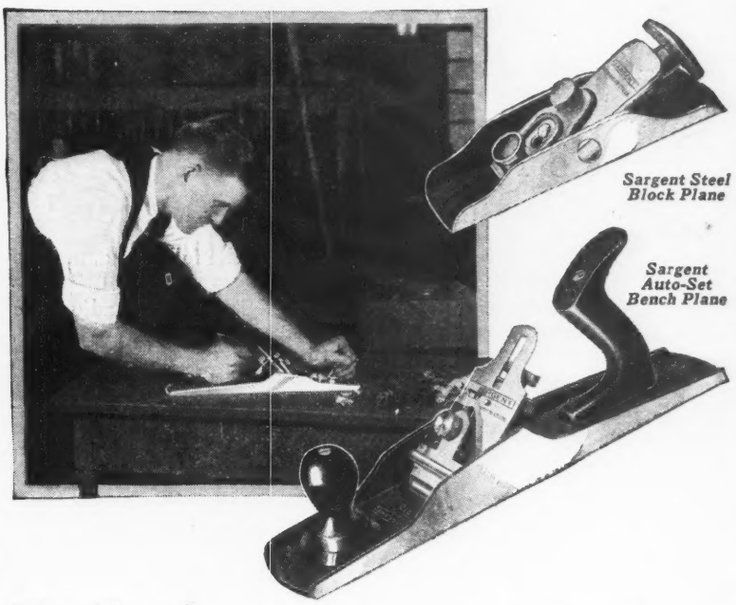
When one upright has been laid out as shown, it may be used as a templet for the others, as well as the uprights of the other two stands shown.

After the top has been cut out, find the center on the under side by drawing cross lines and mark the position of the standard. After placing the dowels in the standard, mark and bore corresponding holes in the top, being careful not to go clear through. With the standard and top in position, bore four slanting holes in the top of the standard, countersink and after applying glue, make a rigid joint by tightening the 1¼-in. screws.

(*Continued on page 128*)

SARGENT

PLANES



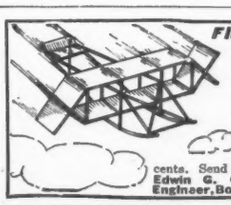
Built for master carpenters .. best for home workshops

SARGENT Planes have been used for years on construction work from one end of the country to the other. They are fashioned from finest metals, perfectly finished and easily adjusted. They are designed to make short work of the hardest jobs, to stand up under the strain of constant usage. Yet they are so moderate in cost that they should be on every home or school work-bench.

You need the two types shown above. The larger is the Sargent Auto-Set Bench Plane. The auto-set feature permits the chromium steel cutter to be removed for whetting and replaced without changing original adjustment. The Sargent Steel Block Plane is great for smaller jobs and cross-grain or knotty surfaces. See both at your hardware dealer's and write for booklet.

SARGENT & COMPANY, *Manufacturers*
50 Water Street, New Haven, Conn.

PLAY A TUNE IN 10 MINUTES! On Ukulele, Banjo Ukulele, Mandolin, Tenor Banjo or Guitar. Amazing new invention. No knowledge of music necessary; no practice—you can play tunes right away. Easily attached to any instrument. Simply press numbered keys. Finer tone than when played the old way. Send for FREE BOOK and bargain catalog of musical instruments. No obligations. Have fun, money, popularity. Write today.
Free Book
FERRY & CO., 3222 N. Halsted St., Dept. 9781, Chicago, Ill.



Flies Without Motor
The GETTINS OCTOPLANE
Altitude Record 2020 Ft.
Glide Record 5146 Ft.
Book giving detailed instructions and license under Pat. No. 1459232 enabling anyone to build one of these wonderful gliders 5 feet long, and information about contest in which you may win a silver cup, sent postpaid for 54 cents. Send for it today.
Edwin G. Gettins, Aero-Mechanical Engineer, Box 1847, Los Angeles, Calif.

CLASS 25¢ PINS
BUY DIRECT FROM THE MAKER
CATALOG FREE
Either pin shown made with any 3 letters and 2 figures. 1 or 2 colors enamel. Silver plate 25¢ ea. $2.50 doz. Sterling silver. 40¢ ea. $4.00 doz.
BASTIAN BROS. CO.
591 Bastian Bldg., Rochester, N. Y.

$1 DOWN
21 Jewels
Nothing less than 21 Ruby and Sapphire jewels is good enough for Burlington masterpiece.
Quality and Style
Adjusted to the second—temperature—isochronism—positions. 25 year Gold Strata Case, in 100 designs. $1 down. Balance in small monthly payments. Send for free book.
Burlington Watch Company
19th Street and Marshall Blvd., Dept. 12-61, Chicago, Illinois

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So Natural You Want to Look Inside for the Performers!

You'll be genuinely surprised at the full, round, musical tone of this new Cabinet Audiophone.

Its "voice" is not a phone unit. It is an adjustable electromagnetic device that gives pleasing quality to the most powerful tones, yet is as sensitive as any loud speaker ever built. For distance "fishing," or for volume on concerts, it gives you radio at its best.

Genuine mahogany. Size 17 x 10 x 10¼, just right for top of radio set or phonograph. Price, $30.00 at your dealer's. Other Audiophones at $25.00, $20.00, $15.00 and $12.50.

Ⓢ

The Bristol Company, Waterbury, Conn.

TRADE MARK

Bristol AUDIOPHONE

REG. U. S. PAT. OFFICE

LOUDSPEAKER

At last! a 100% Woodworker

Only $225.00 complete with motor

Ⓢ

8 inch Circular rip saw
8 inch Circular cross cut saw
11 inch Band saw
4 inch Jointer, Shaper
10 inch sander
Lathe - 14 inch swing

PARKS Cabinet Shop Special is as complete a small shop equipment as you can buy! Everything in one compact unit with motor!

Just the machine for your home shop—for the cabinet maker—novelty and toy-maker—special furniture builder—for the farmer who makes his own crates, bee-hives, etc. No end to its usefulness!

Complete, or without motor and attachments to suit your needs.

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The Parks Ball Bearing Machine Company
1547 Knowlton St., Cincinnati, O.
Canadian Factory: 200 Notre Dame East, Montreal, Can.

PARKS
WOODWORKING MACHINES

FREE Greatest Catalog of Radio Bargains

SEND FOR IT TODAY

It contains a thousand bargains of everything in radio; parts, supplies, complete parts for sets, complete sets, etc., also a mine of very latest information on all different circuits, complete list of broadcasting stations and other valuable data. Send your name and address and we'll send FREE CATALOG.

BUILD YOUR OWN RADIO SET

All complete parts for the following sets consist of **standard advertised guaranteed parts** and include **drilled bakelite panels** and **wiring diagrams** for easy set construction.

Ultra Audion Circuit	$ 8.95
Five Tube Licensed Neutrodyne	33.75
One Tube Cockaday	10.45
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One Tube Reflex	15.85
Two Tube Reflex	20.55
Three Tube Reflex	27.85
Four Tube Acme Reflex	39.85
Five Tube Improved Cockaday	39.65
One Tube Reinhartz	10.45
Three Tube Reinhartz	17.55
Two Stage Amplifier	10.90

Order from this ad and send for catalog. We pay all transportation charges. Everything guaranteed. Money back if you are not fully satisfied.

FREE SERVICE DEPARTMENT

Our radio engineers will help you solve all your radio problems, and furnish up-to-date information on set construction, operation and improvement. This service is **free** to our customers.

HEADPHONES
"Randolph Special"
2200 Ohm moulded headset

RANDOLPH RADIO CORP.
159 N. UNION AV. Dept. 285 CHICAGO, ILL.

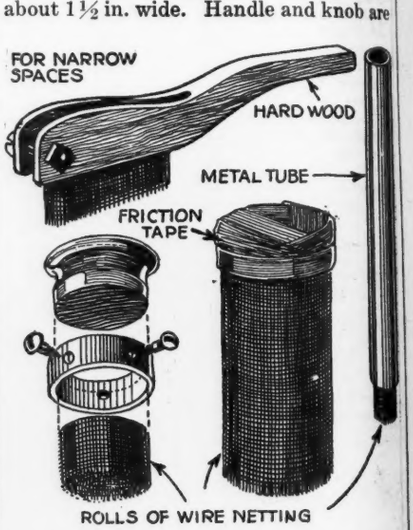
The Home Workshop

Wire Brushes Made Quickly from Rolled-Up Netting

WIRE brushes are exceedingly useful tools in every home, workshop and garage. They are fitted for freeing engines from dust, dirt and carbon, removing paint and varnish, scraping insulation from wire, scouring pots and pans in the kitchen, taking off caked mud from running gears of autos, cleaning files, and many other purposes.

These brushes may be made easily at very little expense. The brush proper is wire cloth cut into strips and rolled or folded to the shape desired. The ends of the wires form the "bristle" part.

Several useful brushes are illustrated. An old wooden drawer pull serves as the handle for the short round brush. The brush part is a long strip of wire cloth about 1½ in. wide. Handle and knob are



Four types of homemade wire brushes. Many others may be prepared as needed

connected together by a strip of metal, which is soldered to the brush and held with small screws or brads to the handle. The method of making the other brushes is obvious. The wire cloth should be of a mesh to suit the work in hand.—S. W. B.

Sturdy Pedestals and Stand

(Continued from page 127)

After applying glue to the inside edges, fasten the four uprights to the standard with long finishing nails. Toenail at the bottom. Set the nails and fill the holes with glue, stain and wood file dust.

Pedestal *B* is similar to *A*, except the thickness of the uprights, which are 1⅛ in., and the faces of the inside standard, which are 2½ in. The top is 1⅞ in. thick and is laid out on a 12-in. circle.

The smoking stand, *C*, is constructed about a center standard 1 in. wide on its three sides. The top may be round or hexagonal, 6 to 8 in. in diameter, and ¾ to 1 in. thick.

The wood should be well sanded and all edges chamfered before finishing. A bog or weathered-oak dye is recommended, followed by a light filler and a flat varnish or wax well rubbed.

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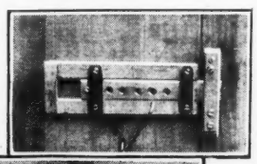
The Home Workshop

Unique Safety Lock Opened by a Key Made of Bent Wire

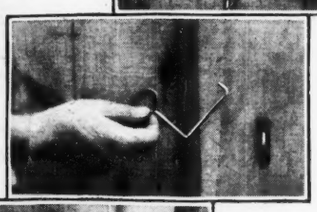
FOR the door of a boy's room, the safety lock illustrated may be made cheaply and easily. It cannot be picked by any one who is not in the secret and it will hold the door against anything but extreme violence.

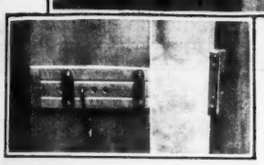
This is also a good lock for a chest, cupboard, toolhouse, or chicken-house.

The lock itself is nothing more than a bolt that is shot home by a special wire key. The bolt, which must slide easily in two guides, may be made of wood, although it is far better to use strap iron. The thickness of whatever material is used depends upon the strength desired. For a small lock the strap may be 4 in. long. One of the guides is at the edge of the door; the other is about 3 in. away. The bolt is drilled with 6 equally spaced holes, as shown. When it is shot, it engages a U-shaped opening, also made of iron, or an iron plate and two wooden spacers.



The bolt, its guides, and the stops that prevent it from slipping too far to the right or left





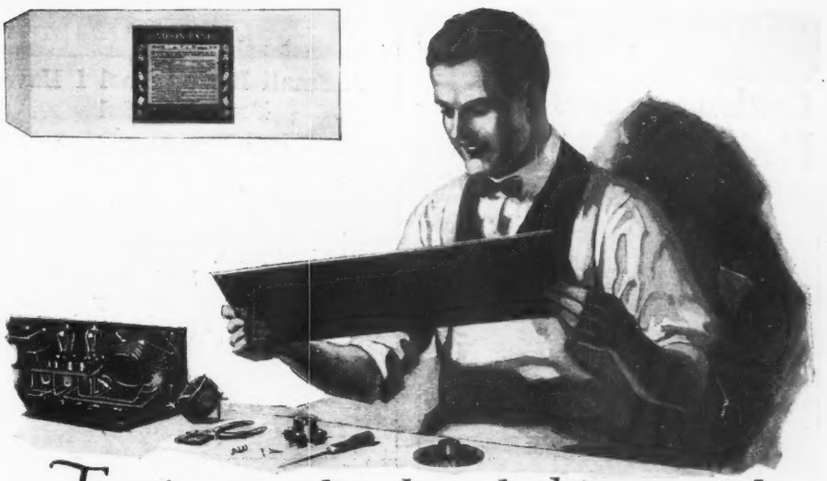
The special key (above) and how it is used to throw the bolt (at left)

The keyhole is placed any distance below or above the bolt; 2 or 3 in. usually is sufficient. The key is a very heavy piece of wire. Beginning at one end, bend ¼ in. at right angles. Measure from this bend a distance corresponding to that from the bottom of the keyhole to the center hole of the bolt. Make a right-angle bend at this point. Leave 1 or 2 in. and bend again to form a conventional key handle.

To open or close the lock, insert the key, turn the end upward toward the bolt, pull the wire toward you, and feel for one of the holes in the bolt. When the end engages a hole, turn the wire like an ordinary key and the lock will open or close, as the case may be.

No other piece of wire except the special key will open the lock, and no one will suspect the method if the work is done carefully.—E. B.

FOR radio material, see "Dressing Up Your Radio Receiver," page 90, and the regular Radio Department beginning on page 76. "BUILDING AN AERIAL MAST" will appear next month.



Engineers developed this special panel material for radio ONLY

THERE is nothing quite like Radion —"the supreme insulation"—for real results. Authoritative laboratory tests conclusively prove highest insulating characteristics. In the set you build, it may give you just that extra energy needed to tune in a distant station. When you see Radion in a ready-built set, it is usually an evidence of general good quality in that set.

The beautiful, high-polished finish of Radion keeps out dirt and moisture, which even in little particles on the surface, sometimes cause short circuits and reduce good reception.

Radion is the easier panel material to drill, cut and saw. There are eighteen stock sizes, two kinds, Black and Mahoganite. Sold universally by dealers who know radio. Better performance will make it worth your while to ask for it by name, and to look for the name on the envelope and the stamp on the panel.

Send for Booklet

Radion dials to match, also sockets, binding post panels, insulators, knobs, and new Radion Built-in Horn. Our new booklet, "Building Your Own Set," giving wiring diagrams, front and rear views, lists of parts and directions for building the most popular circuits—mailed for 10 cents. Send for it today.

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The Supreme Insulation
PANELS
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Please send me your new booklet "Building Your Own Set" for which I enclose 10 cents (stamps or coin).

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TESTS SHOW FORD CAN RUN 60 MILES ON GALLON OF GAS

The amazing fact that a Ford can run 60 miles on 1 gallon of gasoline was recently brought to light through tests conducted by America's foremost engineers. Great strides have already been made in this direction by the recent invention of a simple attachment which can be installed in a few minutes without any alterations to motor. A. C. Winterburn made 41.4 miles on one gallon of gasoline after this device was attached. B. O. Weeks, famous aviator and inventor, wants agents and will send sample for trial. Write him today at 1304-736 Fondulac Ave., Milwaukee, Wis.

N&K Imported LOUDSPEAKER TYPE W

New in principle, new in shape, new in quality of reproduction, price $27.50.

Made by the makers of the famous N & K Head Set, Model D, 4000 ohms, price $8.50.

TH. GOLDSCHMIDT CORP.
Dept. C-1, 15 William St., N.Y.

NEW VEST POCKET ADDING MACHINE

Adds as rapidly and accurately as a $300 machine, yet fits the vest pocket. Mechanically perfect. Easy to operate—nothing to get out of order. Everyone who uses figures should own one.

$2.95

Counts Up to 999,999,999

Total visible at all times. A pull of the finger clears it. Don't carry a pocket full of pencil stubs and scrap paper to do your figuring. Carry a Ve-Po-Ad.

10 Days Trial Send no money. Just name and address and we will send machine postpaid. Pay postman on delivery $2.95. Use it for 10 days to prove it does all we claim. If not perfectly satisfied we will refund your money. Limited supply. Send order today.

Reliable Adding Mach. Corp., Dpt. 46
170 W. Washington St., Chicago, Ill.

AGENTS Here's a money maker. Everybody wants one. Splendid profit. Write for special offer.

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WURLITZER

Couldn't Play a Note—

Now Makes $100.00 a week

"Bill Carola" Landaus Serenaders

Read Bill Carola's story in his own words—

"When I sent for your catalog, I wanted a Tenor Banjo, but I hesitated a long time as I didn't know a note of music. I finally decided to try it a week, as you offered, and at the end of that time I found I could pick a few notes. Then I started the correspondence course you furnished, and in seven months, even before the final payments on the Banjo were due, I had taken my place in a professional orchestra. Now I am making $100 a week, three times what I made as a clerk. Two of my friends made money with their instruments after five months practice, one a drummer and the other a saxophonist, and neither could play a note when he started. I wish everybody knew how easy it is—anyone who can whistle a tune can learn to play a musical instrument."
Bill Carola

New Offer

Learning to Play Made Easy

FREE We now furnish with every instrument a **Free Scholarship Certificate.** This scholarship entitles you to free tuition in one of the foremost correspondence schools of music in the country. Whether you want to learn to play for profit or only for pleasure, this **Free Scholarship** will make it surprisingly easy for you.

Free Trial Easy Payments

You may have any Wurlitzer instrument for a week's free trial in your own home. No obligation to buy. Payments are arranged in small monthly sums, a few cents a day will pay for your instrument. Wurlitzer instruments are the result of 200 year's experience in musical instrument building. Famous for artistic quality, rich tone value and fine workmanship. Used in the finest bands and orchestras throughout the world.

Free Book

Illustrates and describes every known musical instrument—over 3000 articles. Special offers on complete outfits. Special prices direct to you. We also give you our Free Trial, Easy Payment plan and special **Free Scholarship Offer.** No obligation.

Send Coupon Today

The Rudolph Wurlitzer Co., Dept. 1781
117 E. 4th St., Cincinnati — 329 So. Wabash Ave., Chicago
120 W. 42nd St. New York — 250 Stockton St., San Francisco

Send me your Free Book on Musical Instruments. Also your Free Trial, Easy Payment plan and Free Scholarship offer. No obligation.

Name .....

Address .....

City ..... State .....

Instrument .....
(State instrument in which you are interested)

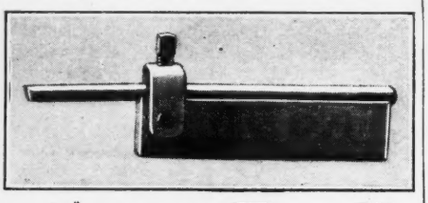
Copyright, 1924, The Rudolph Wurlitzer Co.

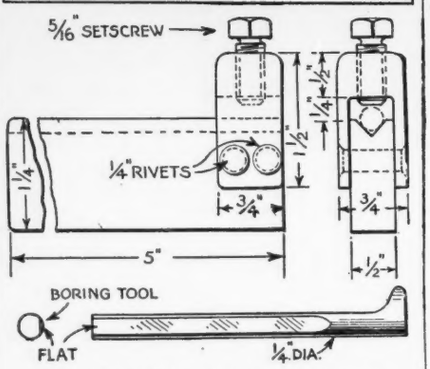
Better Shop Methods

A Small Boring Tool I Have Found Useful

VERY often a mechanic has to have the toolsmith forge a tool for boring small holes or threading a special job. The delay and cost of having this done may be avoided if a holder like that illustrated is at hand.

The body and head are made from scrap steel. It is not necessary to machine the sides of the two pieces; just clean them off against the side of an emery





This simple holder is for use with small boring and threading tools made of drill rod

wheel. The 45-degree V then is milled or cut with a forming tool in the shaper.

Mill the piece for the head to the correct width and depth and clamp it to the body, drilling through the two parts for the rivets. A hole is drilled and tapped in the top of the head for the setscrew. The rivets then are headed and the holder is ready for use.

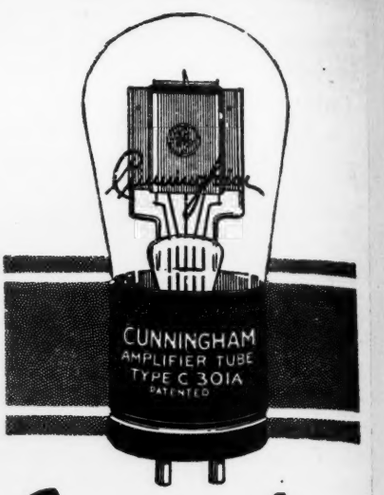
Boring bars and threading tools may be made of drill rod from ¼ to ⅜ in. in diameter for use in a holder of this size.—HARRY E. RICE, Rutland, Vt.

Prizes Offered for Photos of Labor-Saving Tools

"IT COMES in very handy many times in my work about the toolroom," writes Harry E. Rice, a reader of POPULAR SCIENCE MONTHLY, in regard to the toolholder described above.

If you are a machinist, probably you have used a similar idea. At any rate, you have made useful or unusual tools or fixtures for accomplishing work that could not be done easily with your regular tools, or with tools you could go out and buy.

Send clear photographs of any such tools, with a brief description of their construction and purpose, to the Editor, Better Shop Methods Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York. For each photograph available for publication, POPULAR SCIENCE MONTHLY will pay four dollars.



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Price the same on all five types—C-301A, C-299, C-300, C-11, C-12.

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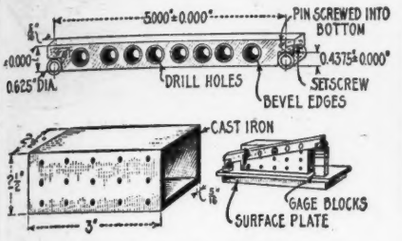
Better Shop Methods

Sine Bar and Parallel Aid in Accurate Tool Work

A SINE bar's accuracy is dependent upon the care taken in making it. Several styles are available and they are made in various sizes.

The design shown below is my own preference. It is made of tool steel hardened and accurately ground. The buttons,



The sine bar is used in conjunction with a special square cast-iron parallel block

which are both the same size, are hardened also and ground. Each is held in place with a short pin that screws into the center. Holes are drilled and tapped in each end of the bar for locking the buttons in place with a setscrew.

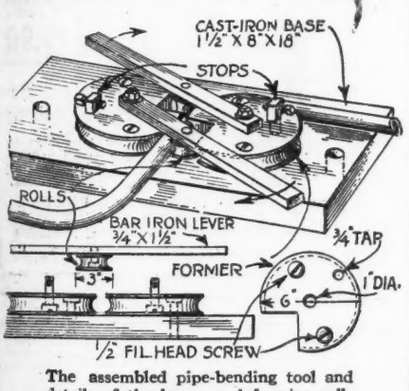
The square, cast-iron parallel is used in conjunction with this sine bar. It is planed square all around and then ground to size. A series of holes is drilled and tapped in one side and the bar is fastened to the parallel with a single screw and washer. Gage blocks can be used to best advantage for setting the angle.

The sine bar and parallel make a convenient set for a toolmaker working on fine tool and gage work.—H. L. W.

Simple Pipe-Bending Fixture

AN EFFICIENT pipe-bending fixture that can be cheaply constructed is shown below. The fixture may be bolted to a bench or wooden block or moved about as necessary.

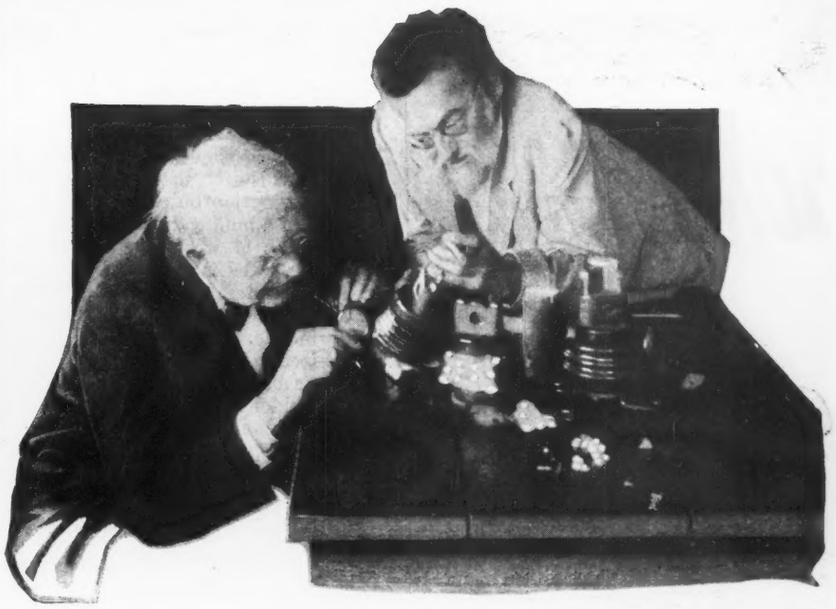
The base is a piece of cast iron planed on one side. The formers and rollers are



The assembled pipe-bending tool and details of the levers and forming rolls

made as detailed. Each former is fastened to the base with 2 countersunk head screws. The stops are riveted to the under side of the formers.

The levers may be any suitable length, but short levers are preferable if the fixture is to be carried from place to place. Additional leverage can be had by using pipe extensions.



Thomas A. Edison and Charles P. Steinmetz in the Schenectady laboratories of the General Electric Company, where Dr. Steinmetz did his great work.

Steinmetz

The spirit of Dr. Steinmetz kept his frail body alive. It clothed him with surpassing power; he tamed the lightning and discharged the first artificial thunderbolt.

Great honors came to him, yet he will be remembered not for what he received, but for what he gave. Humanity will share forever in the profit of his research. This is the reward of the scientist, this is enduring glory.

Emerson tells how the mass of men worry themselves into nameless graves, while now and then a great, unselfish soul forgets himself into immortality. One of the most inspiring influences in the life of a modern corporation is the selfless work of the scientists in the laboratories, which it provides for their research.

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Ⓘ "WONDER" COLD PIPE, TUBING & BAR BENDERS
HAND and MOTOR OPERATED
14 Sizes of Machines
What it costs to bend pipe our way. Per bend.
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are shown in our new 1925 catalog. Thirty styles and sizes shown. A postal brings the catalog.
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Write for literature.

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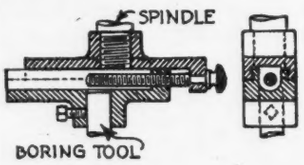
Better Shop Methods

Special Tool-Holder Aids in Many Boring Jobs

THERE are times in the small shop when it is difficult to find a machine to do a boring job quickly. In order to make use of a milling machine or a lathe for this class of work, the boring tool-holder illustrated is useful. At the same time it is considerably easier to make than many other devices that operate on the same principle.

The piece to be bored is fastened to the lathe slide or milling-machine table and the tool-holder is screwed to the lathe or milling-machine spindle.

Two castings and a screw with an adjusting knob are required; a single pattern will answer for both castings. The back casting is bored and tapped to suit the spindle on which it is to be used. It is dovetailed to a neat sliding fit with a front, or tool, casting.



One simple pattern serves for the two castings needed in making the tool-holder

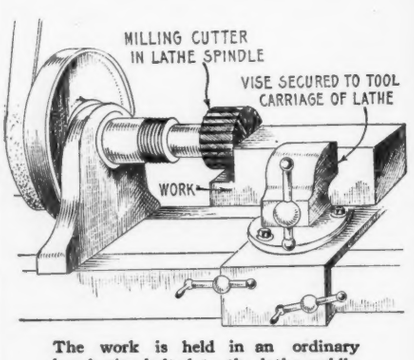
The boss on the front casting should have either a round or square hole for the cutting tool, which is held in place by a setscrew. A ½- or ⅜-in. screw is used for adjustments and the end of the front casting is tapped to suit it.

To assist in setting the tool, inch marks may be marked on both the castings. Start at the center line and mark away from the knob end.—F. N. C.

Bench Vise Used in Milling

ONE of the simplest ways to use a lathe for milling is that illustrated, which is a method used in a small Washington, D. C., repair shop.

A small bench vise is bolted temporarily to the saddle of a lathe carriage in place of the toolpost. The work is clamped in the vise jaws and the tool is fixed in the lathe headstock spindle. End mills, face mills, and either circular saws with the usual taper shank or saw mandrels may be used by this method.



The work is held in an ordinary bench vise bolted to the lathe saddle

Practically any shape of milling cut can be made by shifting the position of the work in the vise and using the feeds of the lathe carriage.

One of the best and most complete saw equipments on the market—
GENUINE $60 VALUE
$35.
East of the Mississippi. We pay delivery charges.
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For Handy Man and Mechanic

With this "little sawmill" you can make your own repairs in shop, home, farm or garage. In 1001 ways it will save its cost many times over. Makes a clean edge on the toughest wood—no planing necessary. Rips, crosscuts, bevels, miters, mortises, tenons, or grooves quickly and accurately. Does the work of a skilled mechanic and saves you time, labor and money.

MECHANICS' BENCH SAWS

Can be attached to any lamp socket. Weight only 61 lbs. This saw will cut up to 1¾". Indispensable to wood workers, carpenters, cabinet makers, pattern makers, model makers, inlaid floor makers, hardwood floor finishers, picture frame makers, farmers, printers, radio builders, schools, colleges, homes, etc. All metal. Saw-size 6 inches. Table 10x13, base 7x11, height 7 inches. Table tilts for beveling 5 degrees left, 10 degrees right. Hinged top for cutting grooves, tenons, rabbets. Bearings solid bronze with grease cup lubrication. Guides removable and adjustable rip and cut-off. Sunlight ¼ h. p. motor; 110 volts; 60 cycle; 4.5 amps; 1750 R. P. M. Current A. C. Centrifugal switch with auxiliary finger. High grade steel shaft with ground bearing surface. Water and moisture proof insulating material used throughout. Exterior connections to allow change of direction of rotation. Large grease cups with wick lubrication. Bearings of Bunting phosphor bronze metal.

COMPLETE OUTFIT including cord, plug, pulley and belt, everything complete, ready to attach. The saw furnished with this outfit is the Disston 6" Novelty Combination Cross Cut and Rip Saw, guaranteed to run without set. No planing or sanding required after cutting. This saw is equipped with extra heavy duty motor guaranteed to handle 50% overload.

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East of the Mississippi. We pay delivery charges.
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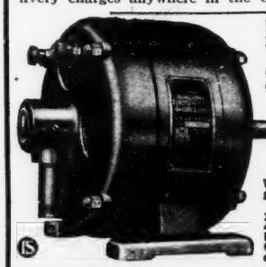
SAW TABLE can be purchased with 6" saw for $22.50; we pay delivery charges anywhere in the U. S.... $22.50

MOTOR This heavy duty Motor can be furnished separately for $15.90; Guaranteed to handle 50% overload; we pay delivery charges anywhere in the U. S.... $15.90



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RADIO SETS $4.95 and up Book FREE

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Write immediately to
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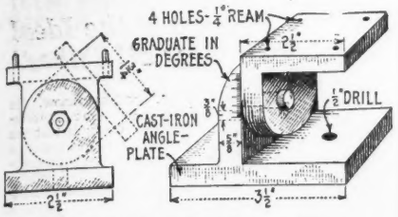
Better Shop Methods

Adjustable Angle Plate for Use on Surface Grinder

THE cast-iron angle plate illustrated is for use on a surface grinder in fine tool and gage work. It must be machined and ground accurately.

The plate will swivel to either side through an arc of 45 degrees. It may be



This angle plate will swivel on either side through an arc of 45 degrees

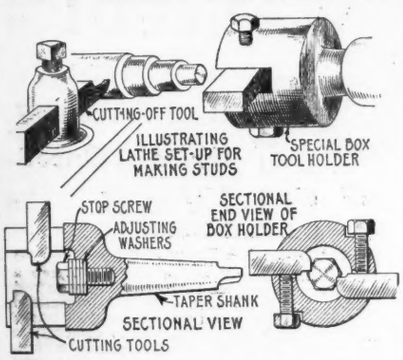
held on the magnetic chuck of the grinder or fastened to the table with a bolt.

Four accurately located holes are drilled in the top surface for pushpins, so that work placed against the pins can be removed and, if necessary, replaced in the same position. The pins are ¼-in. drill rods and should be a push fit in the holes. The work is clamped on the angle plate.

Box Tool-Holder for Tailstock

IN QUANTITY production on small studs, screws, dowels, and a large variety of other work made from cold-rolled steel and brass stock in the lathe, the time lost in making tool changes and taking individual measurements results in high cost and slow progress in the work.

Tool methods for quantity production are not necessarily a matter of intensive study or expensive construction. Fre-



How the tool-holder is used and sectional details showing simplicity of construction

quently some simple and direct means to set up tools jointly is available.

An example of a tool set-up for brass studs is illustrated. The feature is a simple box tool-holder for mounting two tools in the tailstock. One end has a taper shank and the other is cylindrical in shape, with two transverse slots to accommodate two turning tools, these being held by setscrews.

The tools can be removed for grinding, or the position altered as required for turning work within the capacity of the circular opening. At the rear of the tools is a simple stop adjusted by adding washers under the screw head.—A. G.

FOUR TUBES—ONLY ONE DIAL

RADIO is revolutionized by this new receiver! A four-tube set whose loudspeaker range is practically unlimited. Exquisite, natural tone. Extreme sensitiveness and selectivity. And extremely simple operation—single dial control.

Built as only Paragon sets have been built in the past. But basically new, employing the new *non-radiating* Paradyne Circuit. And one third the price you would expect to pay.

The new Paragon line includes the new PARAGON TWO, $27.50, a two-tube set of excellent loudspeaker tone and volume from stations within moderate radius. And the new PARAGON THREE, $48.50, an exceptionally sensitive, fine-toned, three-tube receiver.

Ask your radio dealer to show you these new receivers.

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PARAGON
FOUR
$65

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"Saws in the Shop," "Saw Sense," "Saws on the Farm." Just send us your name and address and say which of these helpful books you want and we will send it FREE. Write NOW.
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Big money can be made. Write for our complete big catalog and particulars.—FREE!
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Direct from our factory to wearer. Easily sold. Over one million satisfied wearers. No capital or experience required. Large steady income. Many earn $100. to $150. weekly. Territory now being allotted. *Write For Free Samples.*
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No matter what kind of work you are doing now, or how much you earn, electricity *offers you more*—a better job and bigger Pay is waiting for you. Trained Electrical Experts are in great demand at the *highest salaries ever known.* The opportunities for advancement and a real success are amazing. The enormous growth of the electrical industry snaps up men *faster than they can be trained.* Electricity needs you.

Be an Electrical Expert Earn $12 to $30 a Day

I will train you at home in your spare time to earn this fine big pay just like the men whose pictures you see here. In a few short months you will be ready for a wonderful job that I will help you get. Lack of education or experience doesn't bar anyone. My simplified, up-to-the-minute, easily learned course, backed up with my 20 years engineering experience, guarantees your success.

W. E. PENCE, Albany, Ore., makes $9000 a year in Automotive Electricity.

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I will give you free a whole outfit of electrical tools, material, measuring instruments and a real electric motor—not toys, but the real thing, such as *no other school* has ever offered before. I will start you right in after your first few lessons doing practical work, in a practical way—work that will pay you extra money while you are learning and from $3,500 to $10,000 a year when you are trained.

J. R. MORGAN, Columbus, Ohio, makes $30 to $50 a day in business for himself.

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The Cooke Trained Man is the "Big Pay" Man

Better Shop Methods

Old Bill's Creed

This is Old Bill, machine-shop foreman, who is the dominating character in the Better Shop Methods Department. He is a mechanic among mechanics, a man among men. His experience, skill, and kindly sayings have been the subject of many stories and will be of many more. His inspiring shop creed appears below

I BELIEVE in the work done in my shop, in the firm I am working for, and in my ability to obtain the greatest possible production with the tools and facilities provided.

I believe that honest and loyal service is given by honest and honorable men; such service I will require from my men and give myself.

I believe that I can get what I want by working for it, and that my success depends upon my ambition, courage, and determination to succeed.

I believe in boosting, not in knocking; in smiling, not in frowning or making alibis; and in initiative, not in waiting to be told what should be done.

I believe that I should study my job and my men and know both thoroughly; that I should give every man a square deal, including my employer.

I will find time to do everything that needs to be done and not grudge a little extra time when occasion demands it.

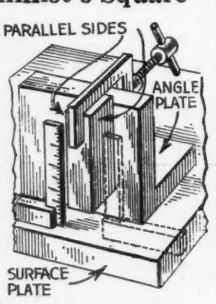
I will meet obstacles with a smile and fight my way through them.

I will have the courage to face all difficulties and embarrassments without whining or weakening and will prepare myself to overcome any that I may meet.

I believe that goodwill is to be found everywhere by the right man, and I am ready to go the whole distance to gain and hold it. I will stick to my job until I win.

Testing a Machinist's Square

ONE of the simplest and quickest ways of testing the accuracy of a machinist's try-square is by means of an accurate parallel strip clamped to an angle iron as illustrated. Place the angle iron on a surface plate and set the parallel so that it touches the edge of the square for the entire length. Then reverse the square.—CHARLES KUGLER.



Placing the try-square

Old Man Ohm Says: *"Here is the Ideal Rheostat for all Tubes"*

Exact size cut of the Marshall-stat

—and he ought to know. He is the fellow who measures resistance. He finds that the Marshall-stat varies resistance not step by step, but smoothly, continuously and uninterruptedly from zero to maximum.

He also finds—and you will too—that the Marshall-stat:

Is compact (see exact size cut at left).

Requires only one hole in panel.

Is vernier all the way but requires only one adjustment.

Can be used with any tube or combination of tubes.

Has only two terminals and cannot be connected incorrectly.

MARSHALL ELECTRIC COMPANY
3241 Locust Bl.
St. Louis, Mo.

$1.75 Ⓢ Marshall-stat

Old Man Ohm has an interesting folder on the Marshall-stat. Send for it.

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Agents are making attractive profits. Here's a wonderful invention that makes any range a real gas range. Does away with dirty, costly coal and wood. Gives better heat than either. Just turn a valve. Takes only fifteen minutes to demonstrate it. A demonstration invariably means a sale. Write today. Let us tell you all about the success other men are enjoying—and about the Oliver Distributor and Dealer Plan.

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OLIVER OIL BURNER CORPORATION
Manufacturers of Oliver Oil-Gas Burner Products
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Oldest and Largest Manufacturers of Oil-Gas Burners in the World

MODERN CARPENTRY
FRED. T. HODGSON
The most practical and complete work on carpentry. Every detail of the work carefully illustrated. 700 pages. Price $3.
POPULAR SCIENCE MONTHLY
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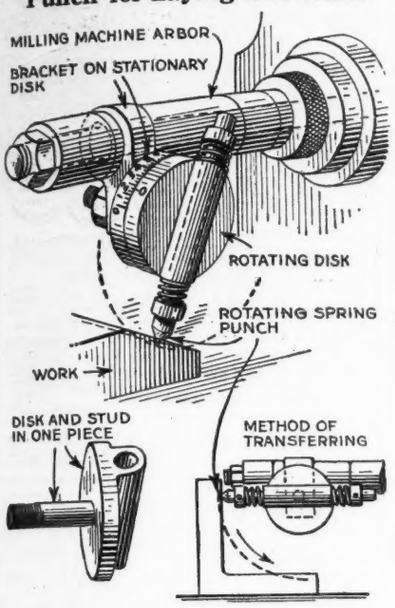
Better Shop Methods

Universal Milling - Machine Punch for Laying Out Work



This punch serves for marking and transferring points in milling-machine layouts

THE punch illustrated, which is attached to the arbor of a milling machine, is a universal tool for laying out work that has been set up for milling operations. It is used for center punching the location of holes, transferring these marks to opposite points, and similar purposes. The punch may be set at any angle quite accurately by means of the scale on the body of the tool.—HENRY S. LARABY, New Haven, Conn.

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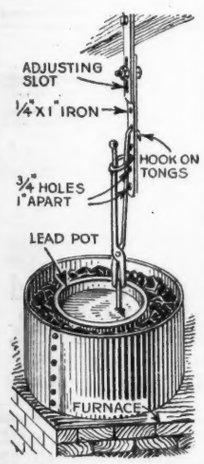
WHEN only one end or a part of small pieces are to be case-hardened and there is a large amount of work to be handled, the method illustrated saves much time.



Work is held at proper depth in lead bath

One or two tongs are made, each with a special hooklike handle and a sliding link. The hook fastens into one of a series of holes drilled in a length of ¼ by 1 in. iron, and this piece is hung from another length of iron. An elongated slot allows the lower piece to be adjusted up and down.

The piece to be hardened is gripped in the tongs by means of the link. If two pairs of tongs are made, one piece may be heated while the other is being dipped or tempered.

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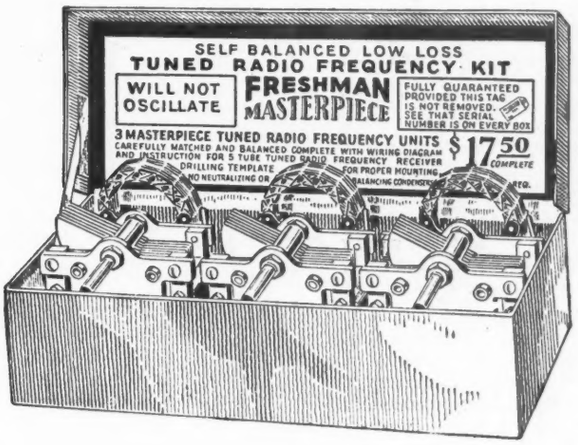
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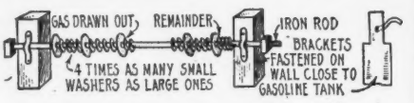
Better Shop Methods

Sliding Washers Serve as Counters for Tally Rack

WHEN drawing gasoline from storage tanks for motor vehicles, an accurate check on the amount used can be kept by utilizing a tally rack similar to that used for billiard scores.

The rack consists of a length of round iron or steel supported by two wooden brackets that are attached to the wall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IRON ROD
BRACKETS FASTENED ON WALL CLOSE TO GASOLINE TANK
4 TIMES AS MANY SMALL WASHERS AS LARGE ONES

Designed after a billiard tally rack, this device keeps account of gasoline

near the gasoline pump. A number of iron washers, representing the number of gallons in the tank, are placed on this rod. To simplify the counting, every fifth washer is of larger outside diameter.

One washer is moved on the rod for each gallon of gasoline drawn out. The storekeeper then can tell at a glance when to order the main tank.—S. H. SAMUELS.

How to Repair the Worn Rack on a Power Hacksaw

THE rack on almost any power hacksaw that has been in use for some time will be found to be worn down so that it is very difficult to get the ratchet on the vise jaw to catch in the rack. The ratchet generally will be worn off until the handle sags enough to allow it to strike on the metal frame with each turn, which also raises the dog until it slips out of the rack.

A repaired rack

Since the rack is an integral part of the vise, it is usually considered impracticable to attempt a repair. However, two saws have been fixed as shown.

The casting of rack and jaw was placed in the shaper and the old rack cut out, leaving a smooth slot. A new rack was milled in a bar of steel and bolted in place, a new bolt hole being required at the jaw end.

The rack was cut longer than the old one, as shown, so that the end bolt in the frame could be used. Because it had been worn blunt, it was necessary to forge the end of the ratchet to a better point.—HAROLD E. BENSON.

Smoothing a Lathe Center

IN SMALL shops where there is no center grinding attachment, much time can be saved when a lathe center becomes rough through running hot, by placing a little powdered emery on the center before the next job is started. Care must be taken to keep the center up against the work, or the emery will grind all on one side. While this leaves a ring on the center, the method serves well in an emergency, in fact, it will be some time before it becomes necessary to anneal and true up the center.—G. E. S.

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And Mr. Bruce is well qualified to testify on this point. He tells us that he averages better than half a tin a day, and he has been smoking Edgeworth for eight years.

Let's see—that's something like 1461 tins for Mr. Bruce, according to our office calculator. But Mr. Bruce's own letter will be more interesting than our comments. Here it is:

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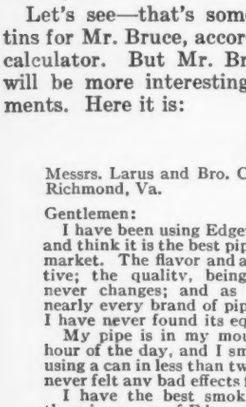
My pipe is in my mouth nearly every hour of the day, and I smoke continually, using a can in less than two days, but have never felt any bad effects from Edgeworth.

I have the best smoking combination there is—a can of Edgeworth and a B B B curve stem—and these two friends, having been with me for eight years, are going to be with me as long as I live.

Wishing you and Edgeworth the best of success, I remain,

Yours very truly,
(signed) F. K. Bruce,
705 East 39th St.



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We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

To Retail Tobacco Merchants! If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

Better Shop Methods

How to Handle Rush Repairs

(*Continued from page 94*)

dimensions (Fig. 4). He showed Old Bill that he had his center line exactly in the middle of the two finished faces.

"Now let us transfer a center line to the planed surface, Bob," Old Bill said. He took a long straightedge and two squares, as shown in Fig. 5, and drew a line on one of the planed faces.

"We could take a square and make a line at right angles to this one, but I had rather do it with the dividers, for we are not taking such a chance on something slipping," Old Bill continued.

Then he took the dividers, and drew arcs on the ends of the jaws, using as a center a point *C* (Fig. 6) on the center line that he had just drawn. Then he drew another arc on each of the jaws, using as center the point *D*, that he had made in the beginning.

HE MEASURED from the inside of the cored recess in the casting and located the point *F* (Fig. 7), which is the center line of the pinhole.

"Set up the casting so that you can plane off the ends of the jaws," he said. "Use these two points *E*, that we have just made to set up by, and plane off the ends so that they are the finished distance *G* (Fig. 8) from the center of the pinhole. Be absolutely sure that you have the set-up right and that the planer cuts squarely down the face. Check it up again before you take the final cut, and don't plane off the marks *E*. Make some more, if you have to take off that much, for we want to be able to know that we are right."

Somehow or other a good many of the machinists in the shop seemed to have business around that planer this morning. They wanted a bolt, or a toolholder, or admitted that they just wanted to watch Old Bill lay out the job.

"He gets those lines drawn just where he wanted them the first time," one of the interested onlookers said to Bob.

"I saw Conley laying it out," another observed, "and he did not plane that end off at all."

"He said that he could do it quicker in the lathe," the first answered.

"Maybe he could, but he didn't get that far!" Bob laughed, and went on with his work.

When Old Bill returned, he was leading a couple of men with a truck. They were bringing up a big angle plate that was kept in the toolroom to protect it against damage.

"Now, Bob," he said. "You have come to a very particular part of the job. Set up the angle plate on the table, and line it up with the stroke. Bolt the crosshead to it so that you can plane the surface where the gibs fit on. Put the bolt through one side of the pinhole and leave the other side open so that you can put in a block of wood and find the center again. Get the angle that these faces make with the ends of the jaws, and carefully set up the casting. If you make a little error, there is a chance of correcting it, but we don't want any error at all.

(*Continued on page 139*)

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Better Shop Methods

How to Handle Rush Repairs

(*Continued from page 138*)

Put a jack under the boss end, and brace the other end to the table so that it will not move. Put on some other clamps, if you think it necessary. Get the distance *H* (Fig. 9) from the old one, and make this one like it. Be sure and check up the setting before you finish the surface. Then we shall be ready for the lathe."

IT WAS just a little bit after the usual quitting time when Bob trucked the casting to the lathe. But he kept on working, for he knew that Old Bill wanted some overtime put in. He put the planed ends of the jaws up against the faceplate with a thickness of paper between to prevent slipping. He found a long rod and put a clamp through the pinhole so that with his long rod all the way through the spindle he could pull the casting up tight against the faceplate.

When Old Bill came up, Bob was setting the casting from the edge of the faceplate, using his finished surfaces to measure from (Fig. 10).

"This faceplate runs true," Bob said. "I tried it before I put the casting up."

"You had better put some clamps around the edges so that you will not have to depend entirely on friction to drive it," Old Bill said. "I think that if you bore and chase the hole tonight, you will have done enough. There is a mandrel all ready for the crosshead; you can use it to fit the thread to."

So Bob completed his setting, and then carefully cleaned up the edge of the piston hole so that he could put up a bull center.

"Have to go easy on this," he said to his helper. "It will be different when I can support this end, but I don't want to take any chances until then."

He put up his bull center and turned the outside of the boss. He put up a steady rest on the outside of the boss and bored out the hole. Old Bill had given him some good advice on how to get good threads, and he had not forgotten it. So, a little before midnight, he and his helper went home.

IN THE morning Old Bill came around and tried the mandrel in the thread. "It seems to be a good fit, Bob," he said. "Take it out so that I can see the thread."

"I don't think you will find any fault with that thread," Bob said, as he screwed the mandrel out of the hole.

"It *does* look good," Old Bill commented. "Now get the pinhole bored so that we can get the pin fitted; then put the shoes on, and we shall be able to ship the job today, all right."

Laten quickly took the casting out of the lathe, and took down the steady rest. He cleaned off his faceplate and put the casting back with the long bolt he had used before through the pinhole.

"How are you going to bore that hole with a bolt in it?" his helper asked.

"It's a trick Old Bill taught me long ago," he said. "Whenever there is a piece of work to be set up and clamped, always set it up and clamp it from the largest diameter that you can. I am going to

(*Continued on page 140*)

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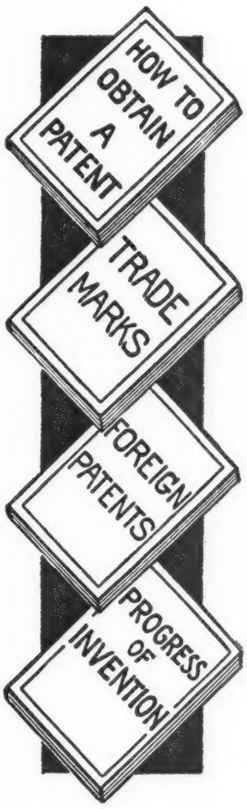

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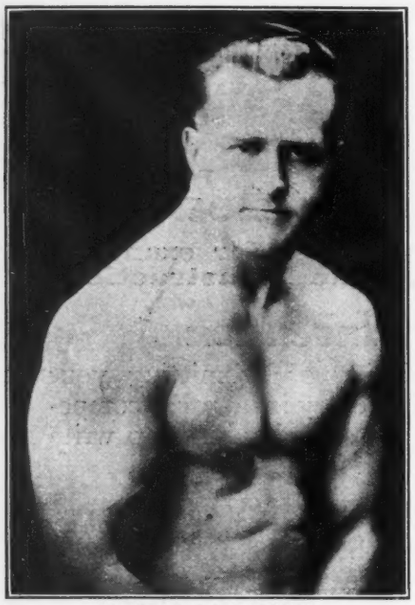

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Stop! Think this over! What are you doing with your own body? Surely you don't want to be put in this class. But if you are not doing everything possible to prolong your life and keep your body just as clean and healthy as your Maker intended, you are inviting death. You are slowly but surely killing yourself.

A New Life

Have you ever enjoyed the pleasures of perfect health? Have you ever felt the thrills which accompany a strong robust body? If not, you have nature's biggest gift awaiting you. That is what I have to offer you. I don't promise to feed this to you in pill form. No, you have to work for it. You can't get anything in this life without effort. Don't let anyone fool you by telling you different. I'm going to make you work, but oh boy! how you'll like it. After a few days you will feel the old pep shooting through your veins and you will crave your exercises like a kid wants his bread and sugar.

Today Is Your Day

This is your birthday. Today you start a new life. I'm going to make a real live, "rip-snortin'," go-getter out of you. I'm going to expand that chest so it will give your lungs a treat with life-giving oxygen. This will put real vim into your blood and shoot it throughout your entire system. I'm going to broaden your shoulders and strengthen your back. I'm going to put a ripple of muscle up and down your body that will make a big powerful he-man out of you. You will have the arms and legs of a modern Hercules. I'll clear your brain and pep up your entire system. You will be just bubbling over with vitality. You will stretch out your powerful body and shout for bigger and greater things to accomplish. Nothing will be too difficult for you to tackle.

Sounds good, doesn't it? You can bet your Sunday hat it's good. It's wonderful. And it's no idle prattle either. I'm not promising these things. I guarantee them. Do you doubt me? Make me prove it. Come on. Atta boy. Let's go.

Send for my new 64-page book

"MUSCULAR DEVELOPMENT"

It Is FREE

It contains forty-three full page photographs of myself and some of the many prize-winning pupils I have trained. Some of these came to me as pitiful weaklings, imploring me to help them. Look them over now, and you will marvel at their present physiques. This book will prove an impetus and a real inspiration to you. It will thrill you thru and thru. All I ask is 10 cents to cover the cost of wrapping and mailing and it is yours to keep. This will not obligate you at all, but for the sake of your future health and happiness, do not put it off. Send today, right now, before you turn this page.

EARLE E. LIEDERMAN
Dept. 1301 305 Broadway New York City

EARLE E. LIEDERMAN
Dept. 1301, 305 Broadway, New York City

Dear Sir:—I enclose herewith 10 cents for which you are to send me without any obligation on my part whatever, a copy of your latest book, "Muscular Development." (Please write or print plainly.)

Name_____

Address_____

City_____ State_____

Better Shop Methods

How to Handle Rush Repairs

(Continued from page 139)

take a little cut off the four corners (*K*, Fig. 11). Then they will be parallel with the finished face of the casting, and also with the center line. I will turn the casting around so that I can put parallel strips under the corners, and then I shall have the supports as far out as the clamps.

"If I had put the parallel under the boss, I could easily tilt it a little at one side or the other. If I did that, I should not have the hole square with the center line. Then the man who will run this engine would wonder what made his crosshead brasses run hot."

Bob had not noticed Old Bill coming up, and was rather surprised when he felt a hand laid on his shoulder and heard Old Bill say, "I wish that all my men would think things out like that, Bob."

When the casting was turned over, trued up, and securely clamped, Laten took a roughing cut through both jaws of the casting. Then, with his protractor, he measured the angle that the tapered hole made with the face of the casting. He set his compound rest to this angle, and bored the hole, both sides of it. He made the diameter about 1/16 in. smaller than the old one.

"I THINK that this one has been bored at least once to fit a new pin," Laten explained, "so it is larger now than when it was new. And it is much easier to make the pin fit the hole than it is to try to make the hole fit the pin."

Presently he had the hole bored to his satisfaction. He had taken a very fine and smooth cut through it. He took it out of the lathe again, and laid off the holes for fastening the shoes and for the studs that adjusted the shoes.

When these holes, and the hole that formed the keyseat to keep the pin from turning, were drilled, he got the shoes and put them on. Old Bill had given him the diameter of the guides on the first little sketch. He set the shoes out so that he had just a fraction to take off.

"Want to keep all the babbitt here that we can," he remarked to his helper.

He was about to screw in the mandrel when the machinist who was fitting the pin came over. "Let me try it in once more before you put it in the lathe," he said. "I think I have it just about right."

They put the pin in the hole. The streak of chalk that they had put on the fitting surfaces was all rubbed off, showing that the taper fitted from one end to the other.

"Now, when you get the shoes turned, it will take only a little grinding to make it absolutely perfect," the machinist said. "I am glad that you made a smooth hole."

It did not take long to get the shoes turned off to the proper size. Laten dressed out the oil grooves in the shoes while the other machinist ground in the pin with fine emery and oil.

Presently all of the rough corners on the crosshead were filed off, and Old Bill had looked it over once more to be sure that it suited him. It did.

For Christmas—
Ask Him For One!

On Christmas morning, when the curtains are pulled aside and the tree in all its splendor is disclosed to the happy, expectant children, be sure that among their gifts they will find a Hohner Harmonica.

There's nothing like good music for Christmas; and there's nothing like a Hohner for good music. Get a Hohner Harmonica today—50¢ up—and ask for the Free Instruction Book. If your dealer is out of copies, write M. Hohner, Inc., Dept. 182, New York City.

If you want a musical treat ask to hear Victor Record 19421, by Borrah Minevitch.

HOHNER HARMONICAS

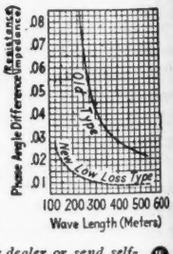
The Coil
WITHOUT LOSSES

The New
UNCLE SAM
MASTER TUNING
COIL

Laboratory tests prove conclusively that it is the only coil worthy of the name low loss.

A Few Features of This Wonderful Inductance:

1—Wound on moulded hard rubber.
2—Wound with genuine Ambassador Litz wire.
3—Eliminates adhesives.
4—One hole mount in thin gold plated compensating spring contact.



FREE—*Ask your dealer or send self-addressed stamped envelope for diagrams of circuits in which this coil can be used.*

UNCLE SAM ELECTRIC CO.
209 East Sixth St., Plainfield, N. J.

Arithmetic of Electricity
A practical treatise on electrical calculations of all kinds reduced to a series of rules. *$1.50 Postpaid.*
POPULAR SCIENCE MONTHLY
250 Fourth Avenue New York

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 31.

George Eastman—Greatest Amateur Photographer

(Continued from page 35)

wishes, and that are equal in quality to those shown in the best theaters. And he can do all this at the cost of a few theater seats.

"Here's a thought, too, that is interesting in this connection. Our first kodak sold for $25. For several years now we have been able to supply a kodak for one-tenth that amount that gives larger and better pictures than those first amateur cameras. It is not unreasonable to assume that home movies will go through a somewhat similar development; that in a few years you can project motion pictures on the walls of your home for very little more than it costs you now to place a still picture in your album or to have one framed.

"ALSO, motion pictures made directly in natural colors are bound to arrive sooner or later. Indeed, the amateur movie-maker of a few years hence probably will make the work of the professional of today seem crude and ridiculous.

"In our research laboratory 120 trained workers—physicists, chemists, and photographic experts—are laboring constantly to bring things of this sort to pass.

"'Find the facts,' the scientists who are working there always have been told, 'and the practical application will come as a by-product.'

"That is why investigations of no immediate practical value are going on there constantly. People often are amazed when we tell them we haven't the slightest idea in the world why we are conducting an investigation of one sort or another. They can't see the use of such work. As a matter of fact, it hasn't any use, which is exactly what Faraday, the great father of electricity, said about his first toy motor. 'But,' he added, 'what use is a new-born baby?'

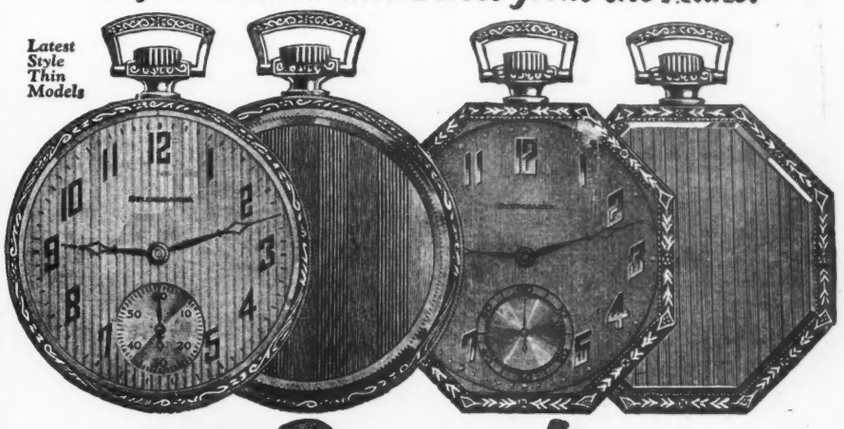
"THROUGH their investigations into the fundamental principles of color and light, our scientists were able to tell the navy authorities what colors to use in camouflaging ships during the war—that a gray-blue decreased visibility in northern waters, for example, and that a blue-gray brought a similar effect in the south.

"Beyond our own needs, too, the research laboratory has yielded rich results even in fields not connected with photography. We issue scientific papers describing our experiments and their results just as the college and government scientists do. We maintain in the laboratory the only plant of its kind in the United States for the manufacture of synthetic organic chemicals that find wide use in industry and scientific research.

"WHEN the government was training aviators during the war, the problem arose of teaching them to shoot while flying. The infantryman, the artilleryman or the naval gunner could get adequate practice from stationary targets. The aviator, though, required a moving target in the air. It was ob-

(Continued on page 142)

"Buy a Studebaker Direct from the Maker"



$1 Down!

Just $1.00! The balance in easy monthly payments. You get the famous Studebaker, 21 Jewel Watch—Insured for a lifetime—direct from the maker at lowest prices ever named on equal quality. Send at once for FREE Book of advance Watch Styles.

21 Jewel STUDEBAKER -the *Insured* Watch

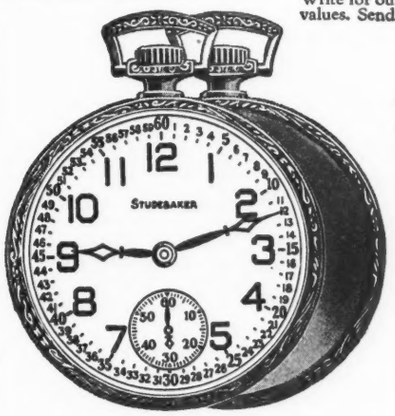
Choice of 54 latest, thin model, Art Beauty Cases in yellow gold, green gold or white gold effects; 8 adjustments, including heat, cold, isochronism and 5 positions. Direct to you from the factory—*the greatest watch value in America today!*

FREE! WATCH CHAIN

For a limited time we are offering a beautiful Watch Chain FREE. Write now while offer lasts.

Write for Style Book! Send at once and get a copy of this book—FREE! See the newest, beautiful, advance styles in Studebaker Art Beauty Cases and Dials. Read how you can buy a 21 Jewel Studebaker Insured Watch *direct from the maker*—save big money—and pay for it while you are using it. Write for our Free Book. It will post you on watch styles and watch values. Send coupon at once. Get Free Chain offer today while it lasts.

STUDEBAKER WATCH CO.
Dept. E23 South Bend, Indiana
Canadian Address: Windsor, Ontario



Mail Coupon for Free Book

STUDEBAKER WATCH CO.
Dept. E23 South Bend, Indiana
Please send me your Free Book of Advance Watch Styles and particulars of your $1.00 down offer.
If you live in Canada send your inquiry to our Canadian office: Windsor, Ontario.

Name .....
Address .....
City ..... State .....
☐ Check here for Ladies' Watch Folder.
☐ Check here for Jewelry Folder.

INVENTORS PROTECT YOUR IDEAS

Send for our Guide Book, **HOW TO GET A PATENT,** and Evidence of Invention Blank, sent Free on request. Tells our terms, methods, etc. Send model or sketch and description of your invention for our **Examination and Instructions without charge.**

RANDOLPH & CO.
Dept. 130, Washington, D. C.

NAME .....
STREET .....
CITY ..... STATE .....

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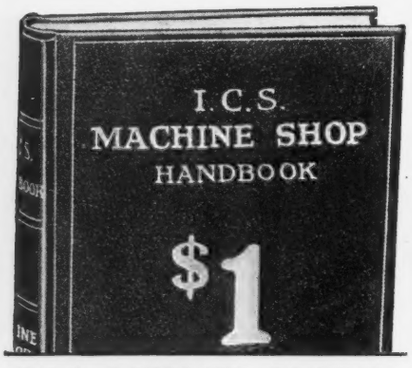


MACHINE SHOP HANDBOOK

A wonderful book for machinists, toolmakers and shop men

335 Pages—282 Illustrations

THIS I. C. S. MACHINE SHOP HANDBOOK is a wonderful bargain at $1. Contains more common sense, practical information than any other book of its kind ever published. Pocket size. 335 pages. 282 illustrations. A book that you will find invaluable in your daily work. Will help you get a better job and a bigger salary.

Price only $1

Contents

Useful tables, mensuration, trigonometry, properties of materials, drilling, reaming, tapping and threading, lathe work, threads and thread cutting, measuring and testing, milling-machine work, indexing, helixes and spirals, key work, gearing, planer work, shaper work, slotter work, broaching, grinding and polishing and lapping, jigs and fixtures, punch and press work, die casting, gauges, micrometers and vernier instruments, lubricants, temperature indicators, metals, heat treatment, chilled iron, welding and brazing and soldering, coating and protecting, filing, stock estimating, chipping, riveting, pipe bending, laying out work, blue prints, belting, pulleys and shafting, knots and hitches, springs and miscellaneous shop hints.

Just mail this advertisement with a dollar bill and your name and address, and this 335-page I. C. S. MACHINE SHOP HANDBOOK or any of the other I. C. S. Handbooks that you want will come to you by return mail. Money back if not satisfied.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7635-D, Scranton, Penna.

I enclose $....., for which send me, post-paid, the Handbooks marked X, at $1 each. It is understood that if I am not entirely satisfied I may return any or all of them within five days and get my money back.

☐ MACHINE SHOP HANDBOOK

☐ Automobile Handbook	☐ Salesman's Handbook
☐ Electrical Handbook	☐ Advertising Handbook
☐ Chemistry Handbook	☐ Bookkeeper's Handbook
☐ Pharmacy Handbook	☐ Civil Engineer's Handbook
☐ Traffic Handbook	
☐ Building Trades Handbook	☐ Steam Engineer's Handbook
☐ Radio Handbook	

Name.....

Address.....

$3 an Hour!

for Your Spare Time or a Real Business Now—later a Fur Shop of Your Own.

Learn "Furcraft"

Learn by mail, evenings at home. Make up new furs and make old furs like new. Learn fur repairing and cleaning. Learn our secret processes. Learn glazing, ironing and storage. Big demand, big need in every neighborhood. An uncrowded field. Learn now. Earnings start in 30 days. Men and women equally successful.

Free Book Tells about this greatest of spare time money makers. Big opportunity **now** in your neighborhood. Be first. **Write at once** for free book and get full details of this money making business.

NORTHWESTERN FUR COMPANY
2753 Sunderland Bldg., Omaha, Nebr.

George Eastman—Greatest Amateur Photographer

(*Continued from page 141*)

viously dangerous to let inexperienced air pilots shoot at balloons or similar objects trailing behind other airplanes.

"Our camera makers designed a special camera which could be affixed to a Lewis gun. When the trigger was pulled, the object that the shooter would have hit if the gun were loaded was photographed. Synchronized stop watches that recorded the time of each shot on the film permitted aviators to engage in realistic but safe practice battles in the air. This was an improvement on the foreign camera-guns, which could only take single photographs from which the winner of the duel could not be ascertained."

This laboratory, of course, is only a single unit in the immense enterprise that has grown from the experiments that young Eastman started in his little Rochester laboratory 47 years ago. In Rochester alone more than 10,000 people help carry on the work of supplying the world with the cameras, lenses, plates, film rolls, photographic paper and chemicals and motion-picture films it requires.

ONE plant—Kodak Park, where film, paper, and chemicals are made—occupies 230 acres, and contains 119 buildings, from which issue, among other things, 150,000 miles of motion-picture film in a year in addition to the kodak film and the film used for professional portraiture and for X-ray work. Here, Mr. Eastman told me, three tons of silver, one-twelfth of all that is mined in the United States, are used every week in the sensitizing of film and photographic papers. A single refrigerating plant there, used for the purpose of maintaining the film rooms at a constant temperature of 70 degrees, yields the equivalent of 4000 tons of ice every day—sufficient for the needs of a city of 200,000 population.

The water supply system maintained at Lake Ontario, six miles away, is large enough to serve a city equally large. The electric power plant furnishes 15,000 horsepower to run 4300 motors and light 40,000 lamps. Five million pounds of cotton are used here in a year in making film, while into the kodaks that are made in the camera works in the city go every year 480,000 pounds of aluminum, 2,000,000 pounds of brass, 1,400,000 pounds of steel, 2,000,000 square feet of leather, and 1,500,000 board feet of lumber. Chemicals and other materials that ordinarily are used only in minute quantities are handled here in carload lots.

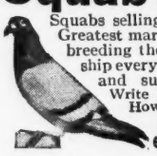
Such figures are staggering, especially when you recall that the products they shape all sprang from the experiments of a single young man, who still remains the active head and guide of the vast enterprise he founded.

FOR, though to the majority of those who use his products George Eastman is a name only, here he is a definite, dominating personality, whose hand is constantly discernible in even the remotest ends of the great business that bears his name. Certainly he is responsible

(*Continued on page 143*)

LATEST WHOLESALE RADIO CATALOG FREE Simply send name TODAY for big 48-page catalog of latest radio goods at Wholesale. *Live dealers and agents wanted.*
STANDARD RADIO CO., 104 East 13th, Kansas City, Mo.

Squab Book FREE



Squabs selling at highest prices ever known. Greatest market for 20 years. Make money breeding them. Raised in one month. We ship everywhere our famous breeding stock and supplies. Established 24 years. Write now for big illustrated free book, How to Make Money Breeding Squabs.
PLYMOUTH ROCK SQUAB CO.
616 H St., Melrose Highlands, Mass.

PLANS for HOMES

"The New Colonials" 50 Houses—6 to 10 Rooms—$1
"All American Homes" 50 Houses—7 to 10 rooms—$1
"South-West Stucco Homes" 75 Duplexes & Bungalows—$1
"West Coast Bungalow Book" 5 to 7 Rms. $1; 3 to 5 Rms. $1
E. W. STILLWELL & CO., Architects, 287 Calif. Bldg., Los Angeles

AGENTS 500% PROFIT
GENUINE GOLD LEAF LETTERS

Guaranteed to never tarnish. Anyone can put them on stores and office windows. Enormous demand, large profits, Paul Clark says: smallest day $28.70. R. L. Reel made $920 in two months. Write today for free sample and liberal offer to general agents.
METALLIC LETTER CO. 433A N. Clark Street, Chicago

"LIGHTING FIXTURES"

Ready to hang.
Direct from the manufacturer.
Completely wired including glassware.
Send for Catalogue No. 26
(Just off the press)
Special proposition to Dealers
ERIE FIXTURE SUPPLY CO.
Desk A. Erie, Pa.

Motorcycle Bargains
SAVE 25% to 65%

on Slightly Used and Rebuilt Motorcycles, Ace, Indian, Excelsior, Harley-Davidson, Cleveland, Side Cars, Johnson Motor Wheels, Evans Power Cycles, Bicycles. Send for **Free Bargain Bulletin and Money Saving Message,** listing hundreds of bargains in used, rebuilt and new machines, supplies, accessories, etc.
AMERICAN MOTOR CYCLE CO.
Dept. 128 2047 W. Chicago Ave. CHICAGO

AUTOMOBILE MAKES 27 MILES ON AIR

An automobile goes 27 miles on air by using an automatic device which was installed in less than 5 minutes. The automobile was only making 30 miles on a gallon of gasoline but after this remarkable invention was installed, it made better than 57. The inventor, Mr. J. A. Stransky, 4141 Eleventh Street, Pukwana, South Dakota, wants agents and is willing to send a sample at his own risk. Write him today.—Adv.

AGENTS EARN A GOOD INCOME
You can sell Premier Knife Sharpeners to housewives, restaurants, stores, etc. 9 out of 10 will buy. Sells for 50c. *Write today for attractive offer.* PREMIER MFG. CO. Dept. 9, Detroit, Mich.

LARGE PROFIT for you

DEALERS SAVE MONEY
By Ordering from Our Bargain Catalog of Nationally Advertised Radio Goods. *Write for It Today.*
AMERICAN RADIO MFG. CO.
Dept. B 6 WEST 14TH ST. KANSAS CITY, MO.

George Eastman—Greatest Amateur Photographer

(Continued from page 142)

for the remarkable spirit that pervades his organization—a spirit of pride and loyalty that is to be noted from top to bottom. People stay with the Eastman organization. A half-dozen with whom I talked had been there a quarter-century or more.

Perhaps there is an explanation of that spirit in the cleanly, sanitary, more than attractive surroundings in which even the most laborious work of the organization is done; in the extraordinary care to safeguard the physical health of the workers.

Perhaps there is another explanation in the system of rewards for mechanical workers who suggest improvements in the machinery and processes. Perhaps the amazing scope of the welfare work carried on among the workers of the Eastman organization may have something to do with it. Perhaps it is in a sense the reflection of the spirit of the man who built and endowed the $9,000,000 Eastman Theater and Eastman School of Music in Rochester; who gave $50,000,000 to hospitals and educational institutions as "Mr. Smith," shielding his real identity, until the law compelled the beneficiaries to make known the name of the donor.

"WHAT is your hobby now, Mr. Eastman?" I asked him after he had traced the progress of the Eastman organization from its humble beginning to its present position as one of the best-known concerns in the world.

"I am an amateur photographer," he replied instantly. "For years I made still pictures; now I make movies. This summer I exposed several thousand feet of film on a trip to Alaska."

An amateur photographer! The man who was an expert when there were no amateurs! The man whose genius put into the hands of all photographers—from the children who snap their first tiny kodaks to the men and women whose skill has won them international fame—the tools with which to practise the art!

Second Prize

(Continued from page 4)

"Three boy scouts had been spending hours trying to photograph birds and animals in the marshes. The article on 'Why Animals Understand Me' was eagerly read and Girard's suggestions opened up a new field of opportunity for them.

"A class of boys raised $20, and with the specifications given by Grant Hector, built a 'Coast to Coast Radio Set' for a little crippled invalid girl.

"The magazine was then passed on to eight pupils who read assigned articles, and each gave a three-minute oral report to the Better English Club.

"Once during the month the class writes a critical paper on the advertising.

"When the November copy arrives the October number will go to the Nevada Mining Camp.

"Was the current number worth the money? I'll say it was."—T. N. KRUGER, Mexia, Tex.

MURDOCK NEUTRODYNE

100.00

Announcing

Licensed by Radio Manufacturers, Inc. NEUTRODYNE Patents Nos. 1,450,080 and 1,489,228 Other Patents Pending

NOTICE
If your dealer doesn't sell Murdock Products write for beautifully illustrated booklets giving complete description of all Murdock Products.

The *new* Murdock 5-tube Neutrodyne with "built-in" Loud Speaker and "B" battery compartment—backed by 20 years experience in making fine Radio Products.

WM. J. MURDOCK COMPANY, 430 Washington Ave., Chelsea, Mass.
Sales Offices: New York, Chicago, San Francisco, Washington, D. C.

MURDOCK
RADIO PRODUCTS
Standard since 1904

BURN YOUR NAME ON TOOLS WITH ARKOGRAF

Protect your tools from theft. Write any name, engrave any design on tools and metal with electricity like writing on paper with pen or pencil. Complete outfit $3.50, prepaid anywhere. Interesting descriptive circulars free. Write to-day. Agents wanted.
Arkograf Pen Co., 1171-A East Stark St., Portand, Oregon

DeForest License

HONEYCOMB COILS
The Universal all-wave inductance. Back and front panel mountings. Send 25c for Super Het., R. F. and Honeycomb Coil Circuits and Complete Catalog.
Chas. A. Branston, Inc. Dept. 9, 815 Main St. Buffalo, N. Y.

Shot Guns Breech Loading $4.50
(Like Cut)

U. S. Cal. 45 B. L. Rifles. Barrels cut to 22 inch length. Rebored smooth for bird shot.
Bird shot Cartridges for these guns..$3.00 hundred
Rifle Barrels interchangeable, same length.....$2.00 extra
Ball Cartridges.....$3.00 hundred
Best Gun in the World for the Price
Leather Scabbard to hold this gun.....$ 1.50
Krag Rifles.....$12.50
Krag Sporting Rifles.....$14.00
Krag Carbines.....$15.00
Cal. 45 Carbines.....$ 3.50
Utility Bags for bait, lunches, etc. Parcel Post prepaid.....40c
Send for Catalog
W. STOKES KIRK, 1627-FB North 10th St. PHILADELPHIA, PA.

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Nothing Like a BUESCHER

True-Tone Saxophone Of Your Own

—To play the newest hits.
—To play with piano accompaniment.
—To play in orchestras.
—To play in bands.
—To put life in every party.
—To make new friends.
—To win a welcome everywhere.
—To make you a leader in church, lodge, fraternity or school circles.
And it is all so easy.

Easy to Play Easy to Pay

Saxophone Book FREE

Every music lover should send for a copy of this interesting book on the history and development of the Saxophone.

It tells which Saxophone takes violin, cello and bass parts, and many other things you would like to know. Also illustrates first lesson. Send coupon for your free copy.

The Buescher Saxophone is so perfected and simplified that it is the easiest of all musical instruments to learn. With the aid of the first three lessons, which are sent free (upon request) with each new saxophone, the scale can be mastered in one hour; in a few weeks you can be playing popular music. Within 90 days you can take your place in a band if you desire.

Try It In Your Own Home

We will send you any Buescher Saxophone, Cornet Trumpet, Trombone or other orchestra Instrument you may select. You can try it six days in your own home without obligation. Easy terms of payment arranged if desired. Mention the instrument interested in and we shall mail you our complete catalog—free.

Buescher Band Instrument Co.
Everything in Band and Orchestra Instruments.
385 Buescher Blk., Elkhart, Ind.

Buescher Band Instrument Co.
385 Buescher Block, Elkhart, Ind.
Gentlemen:
I am interested in the instrument checked below:
Saxophone___ Cornet___ Trombone___ Trumpet___
(Mention any other instrument interested in)
Name_____
Street Address_____
Town_____ State_____

When Men Race with Death

(*Continued from page 37*)

Macready finally straightened it out, and with its tiny 40-horsepower motor spluttering away, got it up about 350 feet and flew it mile after mile, then brought it down to a perfect landing.

The astonishing strides made in aviation since the Wright brothers first coaxed their plane to hop before an incredulous audience, more than a decade ago, was emphasized by what followed Macready's daring flight.

HARDLY had Macready descended when five youths took the air, one after another, in machines of their own manufacture. The first was a spick-and-span little monoplane, painted a bright yellow, with a motorcycle engine as its power plant, piloted by J. M. Johnson, of Dayton. This little ship hopped off with astonishing agility, climbed a thousand feet, and was off in the distance.

Right after the homemade monoplane came the most popular machine of all the 350 at the races—dubbed the "Flying Bathtub," because that's what it looks like. It was piloted by its young builder, E. Dormoy, of Dayton, Ohio, very tense and very proud, as well he might have been, for the machine fluttered unpleasantly, though it did fly with complete abandon. Three others followed in trim little ships.

The five participated in a thrilling 25-mile race, won by Johnson with an average speed of 64.07 miles an hour.

A second light-plane race further demonstrated that there is a great future in air flivvers. It was an efficiency race. H. C. Mummert of Garden City, N. Y., won it, flying over a 50-mile course at an average speed of 38.24 miles an hour. He didn't go very fast, true; but he flew economically. His two-cylinder motorcycle engine consumed little more than a gallon of gasoline. His gasoline tank had a capacity of 14 gallons, so he could have flown from New York to Chicago.

Now, American aviation has not yet developed either airplanes or motors satisfactory enough to make these light planes a commercial proposition. French and English builders are a bit ahead of us in this. But the time will come when Americans will have developed a light plane suitable for general flying, and cheap enough to attract the average automobile purchaser.

THE public, if it knew all the facts about airplane racing, would want to see it continued year after year, until the United States has won for itself an undisputed leadership in the world of aeronautics. That is by no means an impossibility, as a few such facts as these will show:

American planes have flown more than 268 miles an hour. They have stayed in the air 30 hours, climbed 10,000 feet in 10 minutes, carried bombs weighing 4000 pounds, reached an altitude of 35,000 feet, crossed the Atlantic, made a non-stop flight of 2700 miles, crossed the continent from daylight to dusk, sunk battleships 70 miles at sea, and have flown around the world.

What nation can match that record?

How Good The Bristles Feel!

The first thing you notice about a WHITING - ADAMS BRUSH is *how good the bristles feel.* How strong and springy they are! Then you notice what a clean-cut, perfectly-balanced, and "usable" article the whole brush is. Ask your dealer to show you one.

WHITING-ADAMS **BRUSHES**

Send for Illustrated Literature

Making a Brush to Last a Lifetime is a Lifetime Job

JOHN L. WHITING-J. J. ADAMS CO.
Boston, U. S. A.
Brush Manufacturers for Over 116 Years and the Largest in the World

$4000.00 IN TWO MONTHS

Jacob Gordon's Record Making and Selling POPCORN CRISPETTES

Gordon was driving a delivery wagon. Ira Shook, Flint, took in $365.75 in 1 day. Mrs. Lane, Pa., 8000 packages in one day.

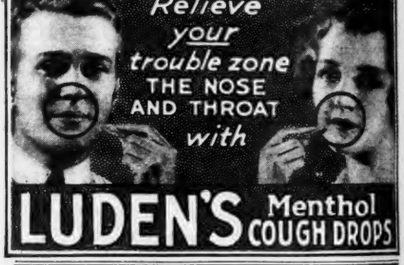
We'll Start You in Business

Furnish secret formulas, raw material, and equipment. Small capital, no experience needed. **Build Business of Your Own!** No limit to sale of Crispettes. Everybody likes this delicious confection. Write for facts about a business that will make you independent. Start in your own town.

PROFIT $1,000 A MONTH EASILY POSSIBLE

Send for book of facts. Contains letters from others—shows their places of business, tells how and when to start, and all information needed. **Free.** Write now.

Long-Eakins Co. 147 High St. Springfield, O.



HAVE YOU AN INVENTION?

If so the WORLD PROGRESS will show you how to

Protect and Profit From Your Ideas

Sample copy free. One year's subscription 40c. Send for free book,

"WHAT TO INVENT"

containing **Suggestions to Inventors** as to Inventions Needed. We invite manufacturers to address us regarding inventions they want.

WORLD PROGRESS PUB. CO., INC.
Room 202 Victor Bldg. Washington, D. C.

Print Your Own

Cards, stationery, circulars, labels. Presses $12 up. Paper Cutters $3 up. Save money. Print for others, big profit. All easy, rules sent. Write for catalog presses, type, paper etc. **THE PRESS CO., F-33, Meriden, Conn.**

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 31.

A Thrilling Search

(Continued from page 40)

ing area, the expedition here divided into two halves, one working east of the river and the other moving through the regions to the west. In this portion of the journey the fallacy of existing maps was fully demonstrated.

From here on there was no lack of thrills. Ice cakes were found to have a habit of breaking off and making plunges that kept the navigator on constant lookout for trouble.

THE boulder belt was another place of navigation under difficulties. Over an area several miles in width the whole channel of the river was studded by boulders large and small. Through these the canoes had to be lowered by means of tail ropes, handled by the voyagers from uncertain footing on the bank, on the slippery tops of the boulders themselves, or in the midst of the current.

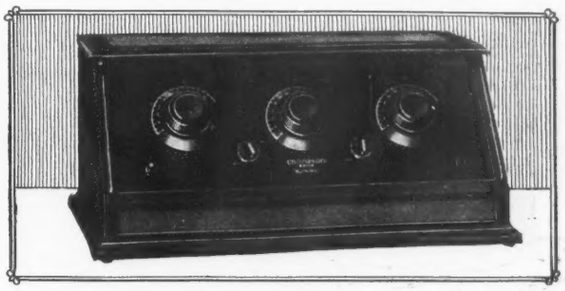
The travelers reached the Colville River after nearly three weeks of such progress down the side streams. The Colville was found to be 300 or 400 yards in width, with swift current. Up and down this Colville and its various tributary streams, the surveyors and geologists worked, making maps, gathering specimens of rocks and making various technical measurements and observations.

Toward the latter part of July both parties began searching for passes through which to advance to other north-flowing drainage entering the Arctic Ocean. Location of a route was followed by one of the greatest portages of the expedition, involving the transport of boats, supplies, and general outfits for a distance of eight or 10 miles across hilly country. This brought the voyagers to canoeing water on the Chipp River. In its lower portion the Chipp River splits into two branches. In following these streams the expedition split into two parties for surveying purposes.

WHEN the expedition was reunited on the south coast of the Arctic Ocean, it remained for the voyagers to make their way to Point Barrow, the northernmost spot on the American continent. This involved a journey of 150 miles westward —a trip undertaken and negotiated in the well-battered but seaworthy canoes. This portion of the trip produced its thrill in the form of enforced isolation on a bleak sandbar for a period of 36 hours.

The experience came during a severe windstorm. The force of the gale was such that the canoeists were unable to reach the mainland and unable to continue their progress. A day and a half of imprisonment on this bleak spot left lasting impressions.

Ice pursued the expedition to the last. After considerable travel in the open sea, the adventurers were forced at last inside a fringe of sand reefs to escape the vast ice-fields along the coast. Even within sight of its goal the party encountered ice troubles of proportions that made it necessary to cut across the narrow sand spit that connects Barrow with the mainland of Alaska. Barrow was reached August 22. From this point vessel transportation to Nome, in southern Alaska, was obtained.



"Experience is the Vital Factor in Excellence"

THOMPSON RADIO

THE THOMPSON COMPANY is the only organization that has been manufacturing radio apparatus *exclusively for fifteen years.* During this time its research laboratories have perfected developments which have contributed largely to the advancement of the radio industry.

This wide experience, now available in the Thompson apparatus, means Receiving sets and Speakers that embody the latest and best practice in Radio Engineering.

A critical investigation of each model will disclose outstanding features of genuine effect, in artistic appearance, naturalness of tone, simplicity of operation.

Radio in the home broadens the scope of human happiness. Every day the broadcast program carries something for every member of the family.

Licensed by Radio Frequency Laboratories, Inc. Boonton, N.J. NEUTRODYNE Patent No. 1,489,228 Other Patents Pending

The 5-tube GRANDETTE is $125. The 5-tube PARLOR GRAND, (shown above) is $145. The 6-tube CONCERT GRAND is $180. Prices are without tubes or batteries. The Thompson Speaker, with conical diaphragm and other special features, is now $28.

Write for attractive literature and name of Thompson dealer near you.

IS R. E. THOMPSON MANUFACTURING CO.

FACTORY: JERSEY CITY, N. J. — 30 CHURCH STREET NEW YORK, N. Y.

DEAFNESS IS MISERY

I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and **my sworn statement** of how I recovered my hearing.

A. O. LEONARD, Suite 301, 70 5th Ave., New York

RADIO SETS — AUTO BODIES

SEND FOR THE INTERNATIONAL CATALOG

Our net price list. Full line of Radio Sets; and auto bodies for Fords at *Wholesale Prices.* Save big money by buying Direct from Factory.

International Body Works, 914 W. Ohio St., Dept. 8, Chicago, Ill.

RADIO OUTFIT Complete $21.95

Long Distance 1-Tube D. K. SUPERIOR Set Complete. Nothing Else to Buy.

Produces astonishing results. Receives music, speeches, information, instruction, sermons, etc., **free to you,** from broadcasting stations hundreds of miles away, often more than 1000. Easy to operate. Cheapest means of entertainment ever devised. No knowledge of radio required. No electricity except supplied by dry battery included in offer. **Satisfaction Guaranteed.** Big bargain—only $21.95 for all parts unassembled and accessories complete. No money in advance.

SEND FOR RADIO BOOK-FREE

100 pages crammed full of interesting information and offers of radio sets and parts at cut prices. Large variety of complete sets, assembled, ready for use. Write today.—NOW!

Liberty M. O. House, D'pt. A185, 106 Liberty St., N.Y.C.

IS This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 31

ZENITH
KENNEDY
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MICHIGAN
Howard
OZARKA
MUSIO
PFANSTIEHL
PHOENIX
ANDREWS
MALONE LEMON
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GLOBE
HARMONY
ODELL FERRY
PEERLESS
DUCKS DELUXE
SAAL
AND
MANY
OTHERS

Follow their lead

Thirty-four nationally famous makers of quality sets use Thordarsons as standard equipment. Thordarson produces *more* transformers for *more* leading set builders than all competitors combined. What better evidence is there that Thordarsons are superior?

And why shouldn't they be? They are made and *unconditionally guaranteed* by the world's oldest and largest exclusive manufacturers of transformers — transformer specialists since 1895!

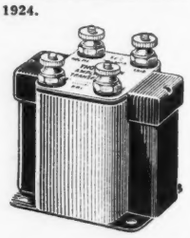
Follow the lead of the leaders—build or replace with Thordarsons or buy Thordarson-equipped sets. All stores can now supply you. Audio Frequency types in three ratios: 2-1, $5; 3½-1, $4; 6-1, $4.50. Power Amplifying (for push-pull circuits), pair $13. Write for latest bulletins—free!

New York City, Sept. 25, 1924.

Thordarson Electric Mfg. Co.
500 W. Huron St., Chicago.

The transformers which you supplied to equip the Radio on the schooner Bowdoin stood the extreme temperature of the Arctic without the slightest mishap. These transformers are in exactly the same condition today as they were the day they were installed, May, 1923.

Sincerely yours,
(Signed) Donald B. MacMillan
WNP



THORDARSON
Super
AMPLIFYING TRANSFORMERS
Standard on the majority of quality sets
Unconditionally Guaranteed by
THORDARSON ELECTRIC MANUFACTURING CO.
Transformer specialists since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Chicago, U.S.A.

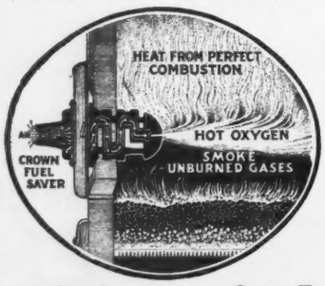
Keep your home
Comfortably Warm
and use less coal in doing it

REDUCE your coal-bills at least 20% and keep your home cozy and warm by attaching the inexpensive CROWN Fuel Saver to your heating plant. More than 15,000 homes and business places are benefiting by the use of this marvelous heat-producer and coal-saver.

GUARANTEED

The CROWN is guaranteed to make at least a 20% fuel-saving or its small purchase price will be refunded immediately.

THE CROWN FUEL SAVER



Burns Smoke Saves Fuel

The CROWN (see illustration) provides an auxiliary supply of pre-heated air which burns the gases that are ordinarily wasted in the form of smoke—giving a tremendous increase in heat. The CROWN insures steady heat and plenty of it on the minimum of coal; less trips to fire the furnace; and a real money-saving over a period of years. Write today for full details and a *free* booklet, "Making the Coal Bill Look Like 30 Cents."

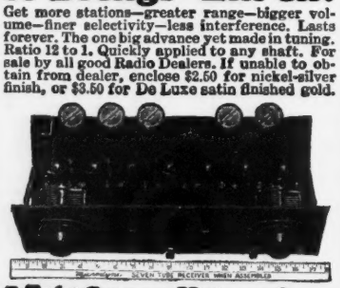
C. F. S. Co., 11 N. 10th St., Richmond, Ind.

Distributors Wanted—Write for interesting proposition.

APEX VERNIER DIAL

It Brings 'Em In!

Get more stations—greater range—bigger volume—finer selectivity—less interference. Lasts forever. The one big advance yet made in tuning. Ratio 12 to 1. Quickly applied to any shaft. For sale by all good Radio Dealers. If unable to obtain from dealer, enclose $2.50 for nickel-silver finish, or $3.50 for De Luxe satin finished gold.



7-Tube Super-Heterodyne for $97.50

Receive the parts complete to assemble your own set. Coast to coast on an 18-inch Loop. Assemble this 7-tube Microdyne Super-heterodyne on a 7x18 in. panel in three hours. Parts complete, including drilled and engraved panels, condensers, sockets, transformers, dials connecting plugs, cables, etc., with drawings, diagrams and instructions. Price of cabinet—to fit—on application. If your radio dealer cannot supply parts for complete Microdyne Radio Set, send check or money order for $97.50 and name of your dealer.

APEX ELECTRIC MFG. CO., Dept. 103
1410 W 59th Street, CHICAGO

The Show of a Lifetime

(*Continued from page 44*)

number of solar and lunar eclipses possible in any one year varies. There may be as many as seven eclipses, of which five may be solar and two lunar, or as few as two, both of which must be solar.

It is an interesting fact also that eclipses repeat themselves at nearly the same time and place at intervals of 6585½ days, or a little more than 18 years. This period is called the "Saros." It was known and understood by the ancient Chaldeans, and was used by them to foretell eclipses.

Solar eclipses are of three kinds—total, in which the sun is entirely obscured; annular, or ring, in which all the sun is obscured except a distinct ring around the rim, and partial, in which only part of the sun is obscured. The first two types always are accompanied by the third type.

AND now, in imagination, let us take our position on the morning of January 24, at about nine o'clock, not more than 30 or 40 miles from the center line of totality, on high ground if possible. Through our dark glasses we watch the dazzling face of the sun. At the appointed time one edge of the sun becomes slightly flattened, an appearance that becomes momentarily more pronounced.

During the hour or so that precedes the total disappearance, other effects are observed. The partially exposed disk of the sun may take on a ruddy or reddish hue, the temperature will fall somewhat, accompanied by increasing wind; clouds will collect and lower.

By nine o'clock, totality is approaching fast. Gusts of wind arise. Strange color effects appear. Jupiter, Mercury, and Venus, and some of the brighter stars are seen close by the sun. Weird streamers of light reach out from the sun, and the mysterious "shadow bands" may be visible. If the sunlight is falling on a plain white or light colored surface near you, watch it closely just before totality. On it you may see the shadow bands—singular, wavy lines of light and shade, traveling along with a variable, undulatory motion. The exact nature of these phenomena are not yet understood.

At the instant before totality you will see the moon's thunder-black shadow sweeping across the country from the northwest with appalling speed. If at this moment, you glance at the swiftly disappearing rim of the sun, you may glimpse "Bailey's Beads"—shapeless spots of bright light, fringing the extreme edge of the last rim of the sun. These are caused by the last visible rays of sunlight shining through the canyons and chasms of the mountains of the moon.

AT THE instant of totality the incomparable corona of the sun flashes into view; that glorious halo, pearly, soft, unearthly in color, stretching at times millions of miles into space, and to be seen only during the few seconds of totality. Then the blue-black shadow departs as swiftly and as silently as it came. You may watch in reverse order the great phenomena.

There won't be another chance to see a total solar eclipse in the United States until 1945.

Crime Mysteries Bared

(*Continued from page 52*)

to beat a prisoner until he confessed. With the aid of the Locard microscope the same effect now is obtained by beating his clothes.

In Paris recently a man was found dead in a deserted spot. He had been killed by a blow on the head, and all about the place where the body was discovered were evidences of a terrific struggle. A few days after the body was found the police arrested a man who, they ascertained, was an enemy of the dead man. The prisoner stoutly denied his guilt, and the police were unable to shake his story.

THEN Doctor Locard took the suspect's coat, placed it in a sack, and beat it thoroughly. This he did also with the coat of the dead man. The two samples of dust particles collected by this method were found to correspond exactly when photographed by the microscopic camera. These photographs, introduced in court, went a long way toward convicting the prisoner.

An even more dramatic use of the microscopic camera sent to the guillotine a young Lyons bank clerk for the murder of his sweetheart. This young woman was found strangled in her apartment. The bank clerk, arrested, established what seemed to be a complete alibi.

Doctor Locard examined the body of the murdered girl, and discovered several small scratches on her neck, made by the finger nails of the murderer as he choked her. Next he obtained a specimen of dirt from beneath the prisoner's fingernails.

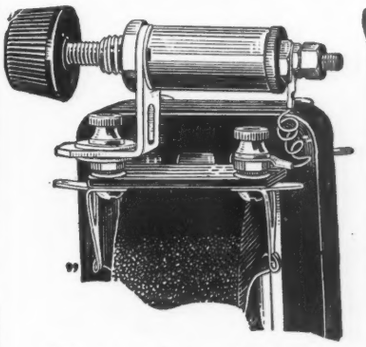
When this dirt speck was photographed under the microscope, exceedingly minute bits of torn flesh were disclosed. Also, there were blood corpuscles. Most important of all, though, there were small crystals, which Doctor Locard established as those of the face powder habitually used by the murdered girl.

In a recent murder case, the microscopic camera in the hands of the police supplied virtually the only evidence against a prisoner—sufficient evidence to convict him. This was a stabbing case, and the police had little to connect the prisoner with it except a possible "motive"—the death of the murdered man was to his advantage. To offset this, the suspect offered a complete alibi.

WHEN all other efforts failed, Doctor Locard suggested that the hands of the prisoner be photographed under the microscope. When the plate was developed, lodged in the pores of the fingers were found traces of blood from the victim's body. The prisoner had washed his hands, but, enlarged 50,000 times, the tips of his fingers yielded the unmistakable evidence that convicted him.

In the police museum at Lyons, Doctor Locard has assembled amazing exhibits of scientific crime detection. Here are remarkable finger-prints; one enlarged 16,000 times, the pores of which appear as large as a fifty-cent piece; another print which recorded itself through a cloth glove, and still another possessing 116 characteristics distinguishing the hand of a murderer who stabbed his victim 32 times for the sum of about two cents!

They Improve Reception

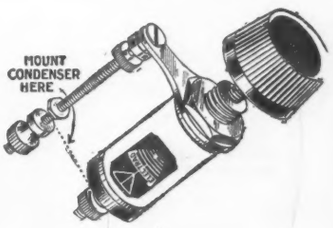


Electrad Audiohm Eliminates Transformer Distortion

Also stops audio-amplifier whistles or howls. Assures a more balanced reception of all notes of music and voice. Makes reproduction free of blur and falsetto exaggeration.

You mount the Audiohm across the secondary of your audio transformer. Can be attached in a minute, and without solder. Easy to operate as setting your watch. Fits any transformer—and lasts for years.

Buy an Audiohm today and get fine reception. We guarantee results. Price only $1.50.



Electrad Variohm Gives That Last Hair-breadth Tuning

Permits you to get stations you never heard before. Clears up those stations you have heard only indistinctly. Affords that superfine tuning which every discriminating fan has long been seeking.

The Variohm is a good, variable grid leak that works with fine precision. Allows much finer variations of adjustment from ¼ to 6 megohms, and coarser adjustment from 2 to 20 megohms.

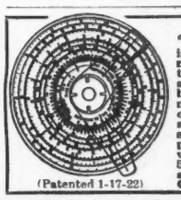
Install a Variohm in your set today—and get the fullest power, clarity and distance from it. Guaranteed.

Price $1.25 unmounted, $1.50 mounted.

Ⓢ **Electrad Audiohms and Variohms are on sale at most good radio stores. If your dealer doesn't carry them, order direct, and give his name.**

ELECTRAD INC.

428 Broadway, New York City



The Midget "*Five-in-One*" Slide Rule is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with Instructions, $1.50. Leather Case 50c extra. Sent C.O.D. if desired. Catalogue Free. **GILSON SLIDE RULE CO., Niles, Mich.**

Clear Your Skin!

Your Skin Can Be Quickly Cleared of Pimples, Blackheads, Acne Eruptions on the face or body, Barbers Itch, Eczema, Enlarged Pores and Oily or Shiny Skin.

FREE Write today for my **FREE BOOKLET, "A CLEAR-TONE SKIN,"**—telling how I cured myself after being afflicted 15 years.

E.S.GIVENS, 153 Chemical Bldg., Kansas City, Mo.

$15 a Day

We want men and women everywhere as local representatives to demonstrate and take orders for Comer Topcoats and Raincoats. New offer enables you to earn $100 a week and a Dodge Touring Car. No capital, experience or training needed. Write for details.

THE COMER MFG. CO.
Dept. O-49, Dayton, Ohio

FREE

How to Build ULTRADYNE

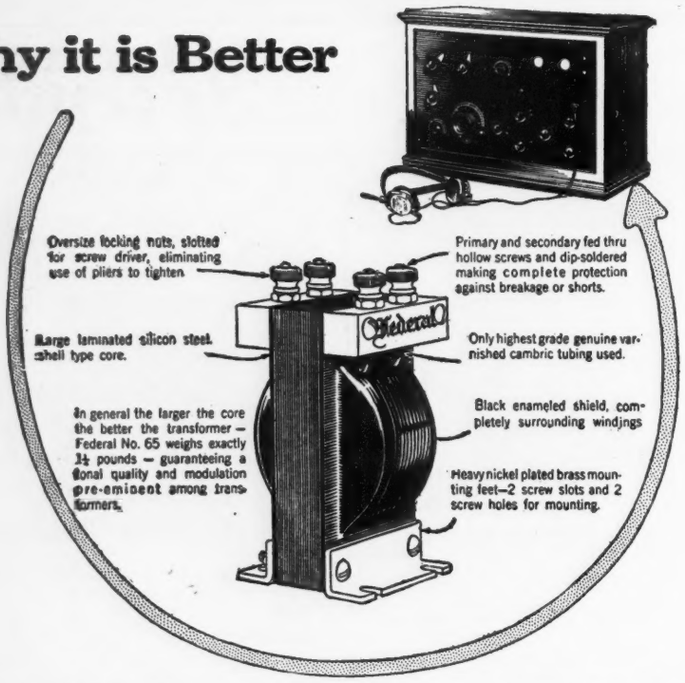
MODEL L-2

32 page illustrated book with detailed instructions on drilling, wiring, assembling and operating Model L-2 Ultradyne Receiver. Latest authentic edition by R. E. Lacault, A.M.I.R.E., inventor of the Ultradyne, the most selective receiver known. Write for descriptive circular.

PHENIX RADIO CORP.
5-7-9 Beekman St., N. Y.

Ⓢ **This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS.** **See page 31.**

Why it is Better


Oversize locking nuts, slotted for screw driver, eliminating use of pliers to tighten
Large laminated silicon steel shell type core.
In general the larger the core the better the transformer — Federal No. 65 weighs exactly 1¼ pounds — guaranteeing a tonal quality and modulation pre-eminent among transformers.
Primary and secondary fed thru hollow screws and dip-soldered making complete protection against breakage or shorts.
Only highest grade genuine varnished cambric tubing used.
Black enameled shield, completely surrounding windings
Heavy nickel plated brass mounting feet—2 screw slots and 2 screw holes for mounting.
Federal

"MASTER of Every Note in the Orchestral Range" is the *proven* claim of the Federal No. 65 Audio Frequency Transformer! Volume without distortion is the basis for the beauty of Federal Tone.

From its oversize locking nuts to its heavy brass mounting feet the Federal No. 65 Transformer incorporates the same engineering skill that has made Federal the recognized leader in electrical communication apparatus since 1890.

Insist upon Federal parts for your "pet" hook-up. There are over 130 standard parts bearing the Federal iron-clad performance guarantee.

FEDERAL TELEPHONE AND TELEGRAPH CO.
Buffalo, N. Y.

Boston
New York
Philadelphia
Pittsburgh

Federal
Standard RADIO Products

Chicago
San Francisco
Bridgeburg
Canada

How I Lead the Largest Gym

(*Continued from page 75*)

Here's an extract from one I received this morning. It comes from a young woman in western Pennsylvania.

"My mother and I want to thank you for solving one of our greatest problems —my father. He retired from business two years ago, and, until your morning exercises started to come in over the radio, he had been the most miserable man in the world. He didn't know what to do with his time, and used just to sit around in my mother's way. Now, though, he's up at 6.30 every day, so that he won't miss any part of your program, and he insists that mother and I do the exercises too. What you had to say about the benefit of fresh air and exercise impressed him so much that he now goes out for long walks, works in the garden, or fixes things around the house. I'm sure you've added to his life, and you've certainly kept my mother from going crazy with him."

One letter like that more than repays me for all the trouble it has been to organize and conduct the class—and I've had 50,000 of them.

AN INGENIOUS young man in Vermont wrote me that he had attached his alarm clock to the switch of his radio set, so that the set is turned on every morning in time for him to hear our alarm from the studio.

Hundreds and hundreds of families of from four to 12 members have formed the habit of doing the exercises together. Here's part of a letter in that regard from a young woman in New York City:

"I'm one of those bobbed-haired stenographers that I heard you telling the people to make get up and do the exercises. I used to lie in bed and laugh when I heard the others taking their daily 'physical torture.' One morning, though, I got up to watch them, and ever since I've been helping them loosen the plaster on the ceilings. You'd enjoy watching us. There's pop, mother, my sister, my brother, and myself, and the baby, who is two, sits on the floor and laughs at us. Please, though, don't tell any more jokes while we're doing the 'front leaning rest.' The other morning I laughed so hard that I couldn't hold myself up, and almost broke my nose and spoiled my beauty."

LEST anybody who sees this be frightened from becoming one of my early birds by that young lady's words, let me hasten to assure you that she, too, was telling a little joke. There really isn't any danger of broken noses, spoiled beauty or any similar casualties in the sort of gymnastics that we do. The contrary is true. It will add to your beauty if you're a woman, and to your health, strength and efficiency if you're a man, to take from 15 to 20 minutes' exercise every morning.

Tune in on WOR some morning if you don't live so far West that our seven o'clock will be the middle of the night for you, and I'll tell you more about it. Or, as I suggested above, try the exercises pictured here for a few mornings. You'll find it the most profitable 15 or 20 minutes you ever spent. For that I have the word of 50,000 people.

An Ideal 'Xmas Gift!

VacuJarm

On the Instrument Board of Your Car

Blows Horn when Gas is Low.

Tells exact amount in tank. Vacuum Indicator warns of trouble in advance.

At your dealers or by Parcel Post, prepaid with complete instructions on receipt of price—$8.90. Installed in 20 minutes. Money back in 30 days for any reason.

THE SMITH MOTOR EQUIPMENT CO.
1955 West 77th St. Cleveland, Ohio

....for *his* Christmas

THE **Simore' Screwdriver** or **Combination Knife** and **Screwdriver** make an ideal gift for the man or boy. Model No. 11 has three screwdriver blades; No. 12 has a fine knife blade and two screwdriver blades—both unusually useful and beautiful tools—blued steel handles—best steel in blades.

They look the part of a real gift for the boy or man who likes tools—try one on a friend of yours and watch him register joy. He'll do it, too.

Model No. 11 only **$1.50** and No. 12 for **$1.80.** Send money order or your check and we will mail post prepaid at once. Each tool guaranteed—your money refunded if not satisfactory.

Dealers are requested to write for our new price list on these tools and the Simore Automatic Trysquare. Boost Simore tools for Christmas.

THE SIMON & SKIDMORE MFG. CO.
Dept. 5-1 Santa Ana, California

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Here Are Correct Answers to Questions on Page 73

1. It is made so that the top part of it is much lighter than the bottom part. Usually there are also ballast tanks to make the bottom part of the submarine still heavier.

2. It rests between beats. The actual contraction of the heart muscle takes only about a tenth of a second. Then it can rest until the next contraction begins, usually about eight-tenths of a second later.

3. Because neither of them contains any nerves. Pain is caused only when a nerve is injured.

4. Eighty-seven are now known.

5. Snow is made up of a vast multitude of very tiny crystals. Each shiny face of each of these crystals reflects light, just as the cut facets of a diamond do. All these reflections from the millions of tiny crystal mirrors combine to make the glistening beauty of snow.

6. It is the system of weights and measures devised by the French Government in 1795 as one result of the French Revolution. The fundamental unit of the system is the meter, a length that originally was intended to be one forty-millionth of the circumference of the earth. It happened, however, that the figure used for the size of the earth was wrong. One standard meter equals about three feet three inches; 3.2808 feet, to be exact.

7. Because the wire keeps the stream of electrons together so that few of them get lost. The electricity goes farther in a wire, just as you can pump a stream of water farther inside a pipe than you can if you merely shoot it into the air.

8. The most distant heavenly object now known is a cluster of very faint stars, far too faint to be seen by the naked eye. It is known only by its catalogue number, N. G. C. 7006. Its distance is about 220,000 light-years. In miles this equals the almost inconceivable figure of 1,293,572,675,000,000,000 miles.

9. It is not the smoothness of the ice that makes it slippery so that you can skate on it; it is something quite different. Pressure melts ice a little. When your skate rests on the ice, the weight of your body melts the ice so that there is a very thin film of water underneath your skate. You really slide along on this water film.

10. Because it is too heavy. The heaviest known rocks weigh less than 200 pounds to the cubic foot. The earth as a whole weighs 345 pounds to the cubic foot. There must be, therefore, a heavy central core of some kind; many geologists think that it is a core of iron.

11. The heat fuses some of the ashes so that the particles of them stick together into solid lumps. Some kinds of coal leave an ash which is more fusible than that of other kinds. So different kinds of coal vary in the amount of trouble they cause with clinkers.

12. When a piece of iron is treated in certain ways it acquires some unusual properties. It attracts other pieces of iron; one end of it tends to point toward the north as the compass needle does; and so on. We say that it is a magnet.

Super-Ducon

A Major Radio Invention

A. C. Type $47.50

D. C. Type $30.00

No more "B" batteries!

The Super-Ducon is one of the most important and valuable radio inventions of the year. It brings many advantages to the set owners. Upkeep expenses are cut. No more of the expense and fuss of installing "B" batteries. No more poor reception due to weak batteries, *but* 100% performance *all* the time!

Ask your dealer for a copy of the 16-page Super-Ducon Booklet.

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CONDENSER AND RADIO CORPORATION

New Hexagon Shaft

Insures Condenser Perfection

To eliminate fanning, the rotor blades are stamped with a hexagon hole and held rigidly on hexagon shaft. Found in types 3 (plain) and 4 (all-vernier), **Celoron End Plates;** types 5 (plain) and 6 (all-vernier), **Metal End Plates.**

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127 Mechanic St., Newark, N. J.

Mfrs. of Special Tools, Dies, Jigs, Automatic Machinery and Sub Presses.

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with an **ASTRA Automatic** will cost little

Nearly every man wants a gun in the house—he feels better able to protect his family. We are able to offer these Genuine Astra guns at special prices because we bought before recent tariff raises became effective. Really fine guns, beautifully finished, hard hitting. Use standard ammunition. Order direct from U. S. importers.

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9.95 25 cal., 7 shot **ASTRA,** triple safety.
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Write for firearms catalogue. **We guarantee** perfect workmanship and material; every gun brand new; of drop forged steel throughout. Before buying any gun insist on this guarantee. **Send no money** unless you wish. Pay postman on delivery plus postage. Money cheerfully refunded if not fully satisfied. **ACT NOW** to get these **SPECIAL LOW PRICES. WRITE TODAY.**

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Dept. 11 747 Warehouse St., Los Angeles, Cal.

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Three hundred and sixty-five days from now—what?

Will you still be struggling along in the same old job at the same old salary—worried about the future—never quite able to make both ends meet—standing still while other men go ahead?

One year from today will you still be putting off your start toward success—thrilled with ambition one moment and then cold the next—delaying, waiting, fiddling away the precious hours that will never come again?

Don't do it, man—don't do it. There is no greater tragedy in the world than that of a man who stays in the rut all his life, when with just a little effort he could bring large success within his grasp.

Make up your mind today that you're going to train yourself to do some one thing well. Choose the work you like best in the list below, mark an X beside it, mail the coupon to Scranton, and without cost or obligation, at least get the full story of what the I. C. S. can do for you.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7632-D, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject *before* which I have marked an X:

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City.....State.....
Occupation.....

Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

A de Luxe Three-Tube Set—1925 Model

(Continued from page 81)

Another way to adjust the condenser, and perhaps the best way, when possible, is to tune in a powerful local station and then turn rheostat *L* out. Now remove the tube in socket *I* and carefully turn on rheostat *L* again. If the signals still can be heard, adjust condenser *H* until they disappear or until they become as weak as possible.

Tuning this receiver is simple. Set the right-hand dial that controls the rotation of coil *D* (Figs. 5 and 7) so as to throw the set into oscillation. Then slowly rotate the dial on condenser *F* until a whistle is heard. Adjust the dial on condenser *E* until the whistle is as loud as possible and then turn back the right-hand dial slowly toward zero until the detector tube stops oscillating.

The signals then should be heard clearly, and slight readjustments of the two condenser dials will bring them to maximum intensity. Whenever you get a station properly tuned in, make a record of the three dial settings and you will be able to find the station at the same point again.

The Eight Most Common Dreams and What They Mean

(Continued from page 43)

missing money." The grown man was so curious that he boarded a train and went to the house in which he had lived as a child. The bed was still there, but a bolt had been fitted into the hole. He removed the bolt, and there at the bottom of the hole was the missing note!

Thus was a long and complicated train of thought started by a sensation. In our dreams we sometimes find similar complexity. So many things happen, and they are so interesting, that we often remark upon awaking from a dream, "It was a regular play."

Often in such dreams, the dreamer finds himself taking the part of one of the leading characters. He is brilliant, much more clever than when awake, and talks with great wit. But it is significant that he never can remember this witty conversation after awaking. He simply has a pleasurable sensation of having been important and clever. This is due to illusion. The same effect would be produced by a large quantity of champagne.

BOOKS of dream poems have been written in which thoughts occurring in dreams are printed in black and white, but these were the result of somnambulism, which is often confused with dreaming.

Somnambulism, which is automatic activity of the brain, explains how men in their sleep sometimes work out problems which they were unable to work while awake. This automatic functioning, which is identical with reasoning done in the daytime, except that it is done in an unconscious state, is sometimes very dangerous. Working in the night as well as in the day, the brain gets no rest and is soon overtaxed.

The clarity of a dream depends altogether on the time it takes one to wake up. As thoughts gather around a sensation, they result in a curious conglomeration, which you straighten out after waking, unconsciously adding fitting elements to them. After a man tells a dream three of four times, it can hardly be recognized as the same narrative. Ordinarily, a dream lasts half a minute or so, although I have heard persons declare seriously that they have "dreamed for hours."

An old man told me recently of a dream of running from Indians. He was back in the valley in which he had lived as a child. He ran for hours, terrified and shrieking, yet the Indians gained on him. At last he felt he was lost, and fell to the ground.

His wife was shaking him. "Calvin," she said, "you have been asleep for two minutes, and you have been struggling like a madman for the last half minute."

Do dreams mean anything? Thousands of dreambooks have been written and no doubt interest in the subject will persist until the end of time, but if I had to answer the question with "yes" or "no," I should choose an emphatic "no."

Since dreams are incited by physical causes, they often tell of disturbances in the body. Some of these are obvious to the dreamer and some are not. A dream may reveal the presence of an illness of which the dreamer is unaware, since in sleep all of the senses are extremely acute. One of my patients, for example, had a series of dreams that a wildcat was clawing at his throat. I discovered that he was suffering from cancer of the throat.

But only in the disclosure of physical disorders or similar things, do dreams have meaning. I have no faith in what are commonly known as "prophetic dreams," those that tell one where to find lost finger-rings and missing wills.

I WAS talking recently with two sisters about dreams. One of them said, "Oh, sister knows all about dreams. They were making a race book down at her office, and one of the horses was named 'Superbum.' Grace had a dream in which she saw bowls of soup. She went down the next morning and bet her money on Superbum, and, do you know, she won, 15 to one?"

What could I say? Soup and Superbum! Surely an omen! All that I can say now is that that young woman is going to lose hundreds of dollars in her lifetime if she keeps on placing her bets according to her dreams.

For every dream of prophecy that comes true, there are 999 that do not. Scarcely a ship sails out to sea without carrying on board at least one passenger who has dreamed that that particular ship will be wrecked during the voyage. What chance has one to prove dreams false prophets when such is the case?

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